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Investigation and Recovery of USS Westfield (Site 41GV151) Galveston Bay, Galveston County, Texas

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Volume 1 Report:
Investigation and Recovery
of USS* Westfield *(Site 41GV151)
Galveston Bay, Galveston County, Texas

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VOLUME 1 REPORT: INVESTIGATION AND RECOVERY OF USS *WESTFIELD* (SITE 41GV151) GALVESTON BAY, GALVESTON COUNTY, TEXAS

U.S. ARMY CORPS OF ENGINEERS
CONTRACT DACW64-03-D-0001
DELIVERY ORDER NOS. 0004, 0005, 0006, MODIFICATIONS 0001, 0002, 0003, AND 0004
TEXAS ANTIQUITIES PERMITS 3878, 4622, AND 5271
NAVY HISTORY AND HERITAGE COMMAND
PERMIT FOR INTRUSIVE ARCHAEOLOGICAL RESEARCH
NOS. PBSJ-2009-001 AND PBSJ-2009-0002

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Abstract

This report represents the culmination of fourteen years of marine archeological investigations by PBS&J (now Atkins North America, Inc.) associated with the Texas City Channel Improvement Project. Over that time span Atkins' investigations of the site of USS *Westfield* (41GV151) have included numerous remote-sensing surveys using various combinations of marine magnetometer, side-scan sonar, sector-scan sonar, sub-bottom profiler, and ROV; three diving investigations totaling 64 dives and over 72 hours of bottom time; and archeological salvage of *Westfield* resulting in the recovery of at least 8,380 artifacts. These combined efforts were undertaken in order to satisfy the responsibilities of the U.S. Army Corps of Engineers under Section 106 of the National Historic Preservation Act (Public Law 89-665; 16 U.S.C. 470) and the Antiquities Code of Texas (Texas Natural Resource Code, Title 9, Chapter 191). The archeological investigations reported in this document were conducted under Texas Antiquities Permits 3878, 4622, and 5271, issued by the Texas Historical Commission, and Federal Permits for Intrusive Archaeological Research on U.S. Naval Cultural Resources, Nos. PBSJ-2009-001 and PBSJ-2009-0002, issued by the U.S. Naval History and Heritage Command. The minimum reporting and survey requirements for marine archeological studies conducted under a Texas Antiquities Permit are mandated by The Texas Administrative Code, Title 13, Part 2, Chapters 26 and 28, respectively. The results of six separate site investigations are reported in this document, including Contract DACW64-03-D-0001Delivery Orders 0004 and 0005, conducted in 2005 and 2006, respectively, and additional site assessments and data recovery conducted under Delivery Order 0006 and four subsequent delivery order modifications in 2007, 2009, and 2010. The results of Delivery Order 0004 conclusively demonstrated that the source of recorded anomaly GV0031 was a shipwreck (and given the site designation 41GV151), which tentatively matched the time period and characteristics of *Westfield*. The results of Delivery Order 0005 further substantiated the identity of 41GV151 as USS *Westfield* and concluded that the site demonstrates several criteria for eligibility to the National Register of Historic Places. Delivery Order 0006 resulted in the data recovery operations, which are the primary focus of this report.

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Acknowledgments

There are numerous individuals and organizations that deserve recognition for their contributions to the completion of this project. Atkins would first like to thank the U.S. Army Corps of Engineers, Galveston District, for their support and assistance in this endeavor and especially Janelle Stokes, Nicole Minnichbach (now with the Philadelphia District), Carolyn Murphy, David Petit, and Sharon Tirpak. Atkins would also like to thank the representatives of the other State and Federal agencies that permitted oversaw various stages of the project, including Robert Neyland, Barbara Voulgaris, Alexis Catsambis, and George Schwarz of the Navy History and Heritage Command, and Steve Hoyt, former State Marine Archeologist for the Texas Historical Commission.

A vast network of archivists, archeologists, and professional and avocational historians also generously contributed their expertise to the mountainous collection of research materials assembled during the course of this project. Those individuals include Andy Hall, Maritime History Steward with the Texas Historical Commission; Trevor Gheradi of SIFerry.com; Conrad Milster, Chief Engineer for the Pratt Institute; Dorothy D'Eletto of the Staten Island Museum; National Archives and Records Administration archivists Rodney Krajca (Fort Worth), Keith Kerr (College Park), Chris Killilay, and Mark Mollan (Washington, D.C.); Bill Ewen and Chris Dougherty of the Steamship Historical Society; G. Wayne Dowdy, archivist at the Benjamin L. Hooks Central Library; Dr. Kevin Crisman and Glenn Grieco of the Center for Maritime Archaeology and Conservation, Texas A&M University; Mark Cowan, architectural project reviewer for the Texas Historical Commission; and Justin Parkoff, *Westfield* Conservator and PhD candidate at Texas A&M University whose dissertation will focus on reconstructing *Westfield*. Special thanks in this category go to Mr. Edward Cotham Jr., who has been an invaluable source of information on *Westfield*'s history, and whose own published work is referenced frequently in this report.

A major result of this project has been recovery from the seafloor of an extensive collection of *Westfield*'s remaining artifacts. For their intensive and painstaking conservation of those artifacts, Atkins would like to thank the staff of Texas A&M's Conservation Research Laboratory including: Director and Department Head of Anthropology, Dr. Donnie Hamilton; Lab Manager, Jim Jobling; Conservator and Project Manager of *Westfield*'s conservation, Justin Parkoff; Conservator and Assistant Project Manager of *Westfield*'s conservation, Jessica Stika, Head Laboratory Conservator, Helen Dewolf; Conservator, John Hamilton; and lab staff, Kim Rash, Chris Cartellone, Andrew Thomson, Catherine Sincich, and Karen Martindale; and military ordnance consultant, Colonel John Biemeck, US Army (Retired).

Atkins would also like to thank the many contractors that provided their expertise and tireless efforts to the diving and artifact recovery field operations: G&S Marine, of Ingleside, Texas; Gulf Diving, LLC, of Freeport, Texas; Scott Glick and his crews from J&S Marine Services, Inc.; Paul Hankins and Tim Williamson of DonJon Marine; Rick Thiel of Navy SUPSALV, and the crews of SUPSALV's Emergency Ship Salvage Materials team; Phoenix International for surveying services during recovery operations and for commercial diver teams; and C&C Technologies for hydrographic surveying.

Finally, the authors would like to thank the many other Atkins employees who made this project a success including Jeff Enright, Jenna Enright and Ray Tubby (nautical archeologists); Matt Elliott (archeological diver); Starr Cox and Justin Winn (dive tenders); Linda Nance (technical editor); Chris Vidrick (word processing and report formatting); Kim Griffin (report reproduction); Ty Summerville (GIS specialist); and, finally, the artifact collecting and cataloging field crew that worked tirelessly in harsh conditions: Vince Valenti, Lisa Hopwood, Tricia Dodds, Ellen Ledgerwood, Kirsten Atwood, Karson Winslow, Katelin Koon, Ty Golgoun, Mike Keepen, Emily McCuistion, Lora Holland, Briana Smith, Colleen Bell, Shannon Cowell, Meghan Egan, Julia Haines, Kenneth Fleming, Sarah Wittenaur, Allison Twist, Justin Telepak, Sarah O'Brien, Brian Teague, and Chris Berry.

The authors of the 2010 draft report are no longer Atkins employees, thus this report was finalized under a subcontract between Atkins and Surveying And Mapping, LLC, where Robert Gearhart, Principal Investigator, is now employed. The Project Archeologist, Amy Borgens, is now the State Marine Archeologist for the Texas Historical Commission. In order to avoid a conflict of interest, she will not be reviewing this report in an official capacity.

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INTRODUCTION

In the summer of 2005, while ground-truthing two magnetometer targets initially located during a 2001 remote-sensing survey in the Texas City Channel (TCC) (Jones et al. 2002), archeologists from PBS&J (now Atkins North America, Inc. [Atkins]) discovered the wreck site of the Civil War gunboat USS *Westfield*. *Westfield* was one of twenty ferryboats drafted into military service by the Union Navy and one of only five ferries from Cornelius Vanderbilt's Staten Island & New York Ferry Company that were converted to gunboats. On the morning of January 1, 1863, *Westfield* was destroyed by her commander, William Renshaw, after the sidewheel steamer irrevocably ran aground on Pelican Island Shoal in Galveston Bay. Following that action, Confederate troops successfully attacked and recaptured the port of Galveston from the occupying U.S. forces in an event later known as the Battle of Galveston. The rediscovery of the wreck in 2005 initiated a process of investigation, research, and interagency coordination that culminated in a large-scale recovery effort to remove the shipwreck from the channel in advance of proposed channel dredging associated with the Texas City Channel Improvement Project (TCCIP). That effort has resulted in the recovery of more than 7,800 artifacts from the site, one of the largest artifact assemblage to be collected from a shipwreck in Texas waters.

The *Westfield* shipwreck site is located in what is now the TCC, near the juncture of the TCC and the Houston-Galveston Navigation Channel (HGNC) (Figure 1). Though the vessel grounded on a sandbar that was only 7 feet (ft) deep (2.1 meters [m]) in 1863, natural scouring of the surrounding and underlying seabed has increased the wreck site's depth to 47 ft. A combination of *Westfield*'s destruction (which included detonating the ship's forward powder magazine), subsequent Confederate salvage, U.S. Army Corps of Engineers (USACE) bay navigation hazard clearance operations, and 146 years of biological, mechanical and chemical degradation have removed nearly all traces of *Westfield*'s wood hull, leaving only a predominantly disarticulated artifact scatter covering approximately 0.7 acre (0.3 hectare). Natural sediment removal processes have outpaced required TCC depths in this area, meaning that the site has heretofore been unaffected by the USACE's channel creation and maintenance dredging operations. The currently proposed TCCIP will deepen the TCC from a design elevation of –40 ft USACE Mean Low Tide (MLT) to –45 ft USACE MLT. This plan includes 3 ft of advanced maintenance dredging and 2 ft of allowable overdepth dredging, making the bottom elevation of new dredging –50 ft USACE MLT, and necessitating the mitigation of these activities on this historically significant shipwreck.

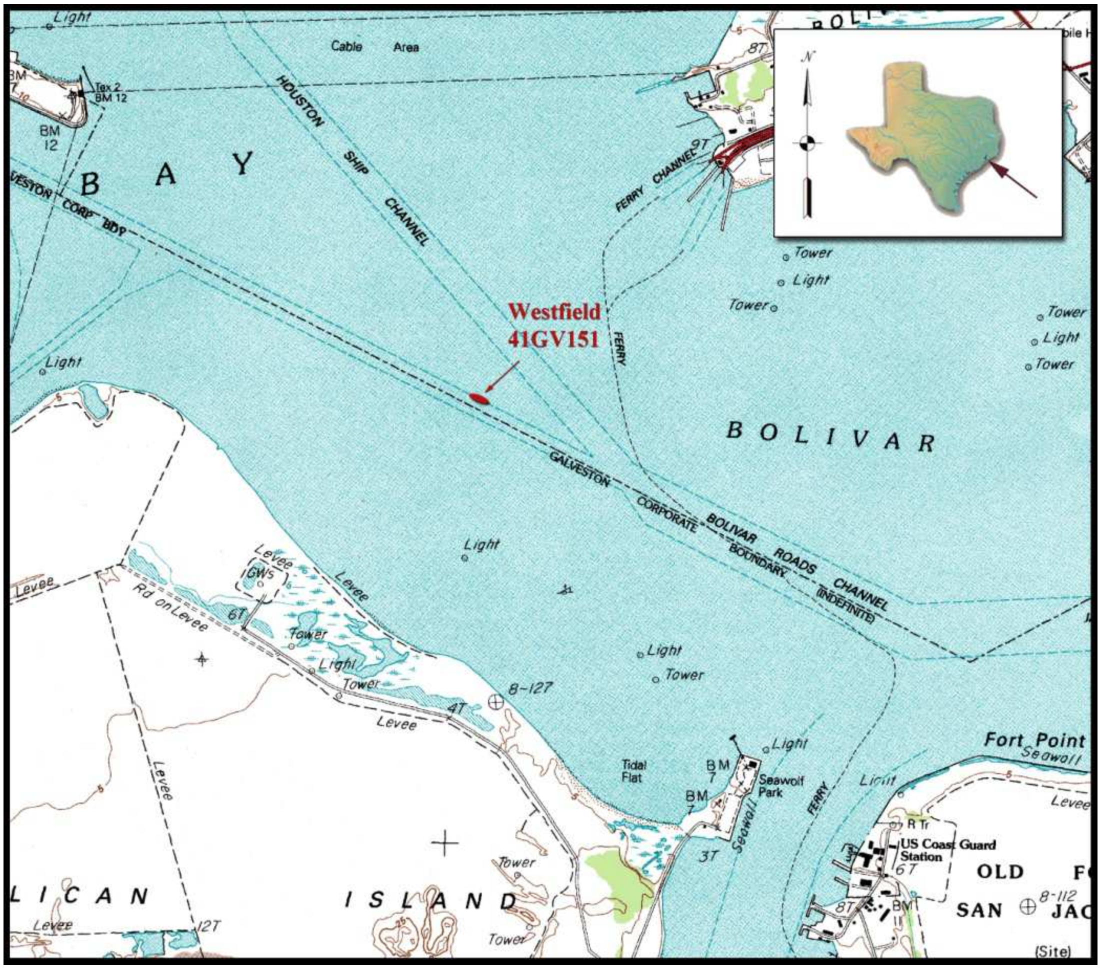


FIGURE 1: PROJECT LOCATION

The USACE initially contracted with Atkins in 2004 to conduct a close-order remote-sensing survey of five magnetic anomalies, including the one (GV0031) that was eventually determined to be the USS *Westfield* (USACE Contract No. DACW64-03-D-0001, Delivery Order [D.O.] 0002) (Gearhart et al. 2005). Since that time, the USACE has funded six additional archeological investigations of the site in preparation for the proposed channel modifications (Table 1). All of these efforts have been conducted to ensure the USACE's compliance with Section 106 of the National Historic Preservation Act, in connection with the TCCIP. Section 106 requires federally funded or permitted projects to give due consideration to cultural resources that may be impacted by those projects. Each of the archeological investigations was further performed under one or more of the following permits: Texas Antiquities Permits 3878, 4622, and 5271, issued by the Texas Historical Commission (THC); and Federal Permits for Intrusive Archaeological Research on U.S. Naval Cultural Resources, Nos. PBSJ-2009-001 and PBSJ-2009-0002, issued by the Naval History and Heritage Command (NHHC).

Fieldwork for contract D.O.s 0004 and 0005 was conducted in August 2005 and June 2006, respectively. A separate draft report of findings was previously submitted and approved by the THC and USACE for each of these projects (Enright et al. 2005; Gearhart et al. 2007). Due to the ongoing

TABLE 1. *WESTFIELD* WORK AUTHORIZATIONS

Work Authorization	Issue Date	Scope	Permit Nos.	
			THC	NHHC
Delivery Order (D.O.) No. 4	August 2005	Diving assessment of two anomalies: GV0031 and GV0032	3878	
D.O. No. 5	April 2006	(1) Substantiate whether site 41GV151 is the wreck of the USS *Westfield*; (2) conduct National Register of Historic Places eligibility evaluation of the site, and; (3) map the horizontal extent and top elevation of the site with respect to the TCC	3878	
D.O. No. 6	May 2007	(1) Close-order remote-sensing survey of the proposed dredged material placement area at the southern tip of the Texas City Dike; (2) close-order remote-sensing survey between the north and south TCC channel toes, within 300 ft of USS *Westfield,* to more accurately map the artifact assemblage, including potential Civil War ordnance locations; and (3) conduct archival research for the purpose of identifying materials having relevancy to the historic significance of the USS *Westfield*	4622	
D.O. No. 6, Modification 1	February 2009	(1) Side-scan sonar, sector-scan sonar, and remotely operated vehicle (ROV) surveys of site 41GV151 to assess site impacts from Hurricane Ike, determine extents of artifact distribution, improve geo-referencing, and investigate isolated targets; (2) underwater archeological test excavations of site 41GV151; and (3) archeological assessment of two anomalies identified in an undredged portion of the Texas City Channel	5271	PBSJ-2009-001
D.O. No. 6, Modification 2	June 2009	Extension of field schedule to complete diving tasks in D.O. No. 6, Modification 1	5271	PBSJ-2009-001
D.O. No. 6, Modification 3	November 2009	Archeological monitoring of large artifact retrieval and reconnaissance by SUPSALV contract divers	5271	PBSJ-2009-0002
D.O. No. 6, Modification 4	December 2009 (verbal approval in November 2009)	(1) Archeological monitoring of clamshell recovery by SUPSALV contractors; and (2) land-based screening of recovered site sediment	5271	PBSJ-2009-0002

nature of investigations and the evolution of archeological knowledge of the site, however, the decision was made by the USACE, in consultation with the THC, to finalize the findings of those reports in combination with a report of the more recent work conducted under D.O. 0006. This document, therefore, includes a condensed presentation of methods, results, and recommendations for the 2005 and 2006 fieldwork (Enright et al. 2005; Gearhart et al. 2007), in addition to the results of D.O. 0006 investigations conducted in 2007, 2009, and 2010.

The USACE sponsored D.O. 0004 to investigate anomalies GV0031 and GV0032 in preparation for the proposed deepening of the TCC. The primary goal of D.O. 0004 was to determine whether *Westfield*'s wreckage was the source of either anomaly, and if so, to provide a preliminary assessment of the wreck's National Register of Historic Places (NRHP) eligibility. The results of D.O. 0004 conclusively demonstrated that the source of Anomaly GV0031 was a shipwreck, which tentatively matched the time period and characteristics of *Westfield*. Anomaly GV0032 was correlated with modern debris. Anomaly GV0031 was subsequently designated as archeological site 41GV151. Side-scan sonar mapping and limited diver investigations determined that an extensive debris field was exposed, which included one cannon, numerous cannon shot, disarticulated elements of machinery, plate iron, and multiple other concreted iron artifacts. Since *Westfield* is the only Civil War naval vessel to have wrecked in this area of Galveston Bay, the artifact typology led Atkins to conclude that 41GV151 was in all probability the wreck of *Westfield* and that it was potentially eligible for listing in the NRHP (Enright et al. 2005).

D.O. 0005 was issued in 2006, authorizing further archeological testing designed to more thoroughly assess the NRHP eligibility of 41GV151. Four research objectives guided the gathering of information to support the NRHP assessment, including (1) positively identifying the vessel wrecked at 41GV151; (2) determining the vertical extent of buried wreckage; (3) mapping the horizontal extent of exposed wreckage; and (4) documenting the physical condition and historic integrity of the site. The resulting study removed any doubt that 41GV151 is the wreck of the USS *Westfield* (Gearhart et al. 2007). No intact hull remains were discovered; however, a substantial amount of cultural material remained, including diagnostic Civil War–era artifacts such as a 9-inch Dahlgren cannon, assorted naval ordnance, and U.S. Navy brass time-fuses. Several small ceramic artifacts were also observed. The results of sediment probing suggested the vertical extent of wreckage was limited to artifacts mixed in a layer of sediment and shell hash, ranging in thickness from 0–3 ft, and overlying a compact clay layer at water depth of –47 ft USACE MLT. Dredging to a minimum elevation of –50 ft USACE MLT, as proposed for the TCCIP, would remove the upper 3–6 ft of sediment from the site.

The results of D.O. 0005 led Atkins to conclude that *Westfield* demonstrated sufficient historic significance, historic context, and historic integrity to make it eligible for listing in the NRHP. The USACE determined that *Westfield* is eligible for the NRHP and requested concurrence of the Texas State Historic Preservation Officer (SHPO) in 2006. Both the SHPO and NHHC concurred regarding eligibility in 2007 (Appendix C-4). Atkins further recommended that site mitigation was warranted by the historic significance of this ship (Gearhart et al. 2007). Following through on these recommendations, the USACE issued D.O. 0006 and four subsequent delivery order modifications for further intensive archeological investigations of 41GV151 in preparation for the site's eventual removal from the TCC. These investigations are the primary focus of this report and include high-resolution remote-sensing surveys of the site and a proposed dredged material placement area (D.O. 0006 and D.O. 0006, Modification 1), archival research at national and regional repositories

(D.O. 0006), and, finally, the excavation and archeological salvage of the wreck's remains from the TCC (D.O. 0006, modifications 1, 2, 3, and 4).

The bulk of this report deals with the recovery and documentation of several thousand artifacts that were removed from the site in 2009. The artifact recovery project was accomplished in two phases: dive investigations conducted in May to test field methodologies; and archeological salvage of the site in November and December. The May 2009 project was designed to test the mapping and recovery methodology Atkins sought to employ during the later large-scale site recovery in the fall. That project's results demonstrated that environmental conditions and vessel traffic hazards combined to preclude safe diver mapping and artifact recovery of the wreck materials. After a thorough review of other non-diver options for artifact recovery, and through discussion with the USACE, NHHC, and the THC, controlled use of an environmental clamshell dredge was selected as the safest and preferred method for mechanical removal of small artifacts and their surrounding sediment matrix from the seafloor. At least 8,380 artifacts were recovered from the seafloor including a 9-inch Dahlgren cannon, steam boiler flues, a bearing block from the walking beam, one boiler firebox, engine and boiler fragments, iron armor plates, ferrous shot and shells, shell fuses, and fragments of glass, ceramic, lead, brick, and coal. Conservation of the artifact assemblage was completed at the Conservation Research Laboratory (CRL) at Texas A&M University from 2010 through 2015.

This report is organized into nine chapters (Volume 1) and five appendices (Volume 2). Chapter 2 presents a detailed account of *Westfield*'s construction, commercial and military use history, and wrecking event. Chapter 3 discusses the relevant physical environment of the site, including tidal currents, geology, erosion history, and biological degradation affecting the wreck. Chapter 4 presents a summary of all archeological projects relating to *Westfield*, dating back to 1980 and including D.O.s 0002, 0004, and 0005, conducted under USACE Contract No. DACW64-03-D-0001. Chapter 5 summarizes major research topics that guided and informed archeological recovery and site interpretation efforts. Chapter 6 describes the methods used to recover artifacts and sediment from the site in 2009, including a critique of the nonstandard archeological methodology employed. Chapter 7 presents an analysis of the artifact assemblage based on the results of five years of conservation and research efforts. Chapter 8 summarizes archeological and historic conclusions based on the many combined studies of USS *Westfield.* A discussion and evaluation of *Westfield*'s NRHP eligibility is presented in Chapter 9. A list of references cited in the text follows Chapter 9.

Appendix A presents copies of relevant historic documentation that was obtained during various archival research trips. Project subcontractor reports are reprinted in Appendix B including a geological site assessment of 41GV151 and reports by all of the major subcontractors involved in the site recovery effort in 2009. The three largest subcontractor reports are provided on pdf and CD only in order to reduce the printed document size. Appendix C includes copies of all relevant State and Federal agency permits, special studies, and report concurrence letters. Site illustrations containing sensitive information are presented in Appendix D. These figures are not for public disclosure and have been provided only to the reviewing agencies. Finally, Appendix E presents the results of a post-artifact recovery magnetometer survey of 41GV151 in February 2010.

2

BACKGROUND HISTORY

WESTFIELD: STATEN ISLAND FERRY AND U.S. NAVY GUNBOAT

USS *Westfield* was the heavily armed flagship of the West Gulf Blockading Squadron, a small Union fleet that was headquartered in Galveston Bay in the fall and winter of 1862. On January 1, 1863, Confederate troops and naval vessels rallied against the occupying Union forces and recaptured the port of Galveston. The primary military engagement occurred at Kuhn's Wharf in the Galveston Channel in the area of 21st Street (it is commemorated with a Historic Marker at the site). Potential historic sites associated with Confederate and Union activities from the battle include the wrecks of USS *Westfield*, CSS *Neptune,* Kuhn's Wharf, and the now-submerged site of Fort Jackson, the Confederate fort on Pelican Spit that was commandeered by the Union Navy. The investigation of USS *Westfield* is the first archeological field project connected to this Civil War battle.

Staten Island Ferry

As part of his growing steamship and railroad enterprise, in 1860 Cornelius Vanderbilt decided to extend his ferry service to connect with the 13-mile Staten Island Railroad, a company in which his brother Jacob and son William had controlling interest. Construction of *Westfield* and its virtual twin *Clifton* commenced on June 1, 1860, at the Jeremiah Simonson Shipyard in New York. They were each built at a cost of $90,000 for Cornelius Vanderbilt's Staten Island & New York Ferry Company (Stiles 2009:337). *Westfield* was a double-ended sidewheel steamer. The main deck had rounded ends. The dimensions listed in the ship's enrollment and licensing documents, dated July 1 and July 10, 1861, were 213 ft 4 inches (presumed to be length at load waterline [LWL] excluding rudders) x 34 ft breadth of beam (lower hull excluding guards) x 12 ft 11 inches (presumed depth of hold measured to floor of boiler room above the bilge) and having a displacement of 891 tons (see copies in Appendix A-1). The maximum dimensions were approximately 225 ft length overall, 63 ft beam over guards, 17 ft depth molded (from underside of main deck to bottom of keel), and with an estimated draft loaded (based on paddle wheel size) of 8 to 8.5 ft. The steamer was powered by a 50-inch-x-10-ft low-pressure vertical walking beam engine constructed by Morgan Iron Works of New York City (Heyl 1965:335).

Thomas Main (1893: 132-133), in *The Progress of Marine Engineering*, described both *Westfield* and *Clifton* as 224 ft long (presumed to be length overall [LOA]) and 977 tons, which is slightly larger than stated in *Westfield's* enrollment records. He goes on to say that each ship had: a single beam engine with a 50-inch-diameter cylinder, a 10-ft stroke; two return flue boilers with a [combined] grate surface of 97 square feet, a heating surface of 2,706 square feet, and producing 30 pounds of steam pressure; 22-ft-diameter paddle wheels with a 9-ft face, producing a speed of 16 miles per hour at 26 revolutions per minute. According to Main these were the first boats with a saloon on the upper deck and the first to have paddle wheel buckets measuring only half the width of the face and staggered to prevent jarring. Main adds that "the boats when under way were in fact very steady." Isherwood (1865: 209) describes the staggered paddles of USS *Shokokon*, also built by Simonson (as the *Clifton II*), in great detail: "…the paddles are so arranged that instead of being in one piece each extending completely across the wheel, they are in two pieces, breaking joints with each other, in such manner that one outboard piece is opposite the space between two inboard pieces."

Westfield was launched into the ferry service on July 2, 1861, almost a month after its "consort" *Clifton* was introduced on the line (*Richmond City Gazette* 1861a, 1861b). The annual license to conduct coastal trade was granted by the District of New York, Port of New York on July 10, 1861 (National Archives and Records Administration [NARA] Washington, Record Group [RG] 45, Box 128). *Westfield* was only active on the Staten Island route for 5 months prior to her purchase by the U.S. Navy. She ran between Whitehall Street (in New York City), Tottenville (Staten Island), and a new railhead at Vanderbilt's Landing (Clifton) (*Richmond County Gazette* 1861c). The sale of *Westfield* and *Clifton* to the government was announced in the *Richmond County Gazette on* December 4, 1861. A single ferry, *Thomas P. Way,* replaced them on the route (*Richmond County Gazette* 1861d).

Historic photographs of *Westfield* and *Clifton* have not emerged; however, *Westfield* was likely designed almost identically to other Simonson-built Staten Island ferries, such as *Westfield II*, *Northfield*, and *Middletown* (Figure 2). *Clifton*, to which *Westfield* was "equal in every respect," was described as having "spacious and well arranged cabins," as being "nicely cushioned," with wheelhouses above the cabins, and with a pleasant promenade covered by a projecting roof (*Richmond County Gazette* 1861a). Simonson's ferries were double-ended and homogenous in appearance, each having two decks, a gangway extending from stem to stern, and a superstructure concealing the paddlewheel that was flush with the gunwale.

The origins of the Staten Island service are rooted in the early eighteenth century, when sloops and other sailing vessels were part of a regular service between Staten Island and Manhattan. The first steam-propelled ferry in the state of New York was *Jersey*, which was built in 1812 and operated on the Hudson River (Cudahy 1990:20–22). Cornelius Vanderbilt introduced the first steam-powered vessel used for the Staten Island service in 1817. This vessel, *Nautilus*, was a steamboat, however, and not a ferry (Cudahy 1990:66). The ferry *Lexington* was contracted by Vanderbilt in 1835 for the New York-Providence route. The steamer was unlike any vessel constructed at the time and included bridgelike arches to counter hogging of the hull caused by its extreme length to beam ratio (205:22). *Lexington* was powered by a single powerful new-type engine and dramatically larger paddlewheels. This vessel, considered to be Vanderbilt's first foray into Long Island Sound navigation, was coined the "fastest boat in the world" after its successful launch (Morrison

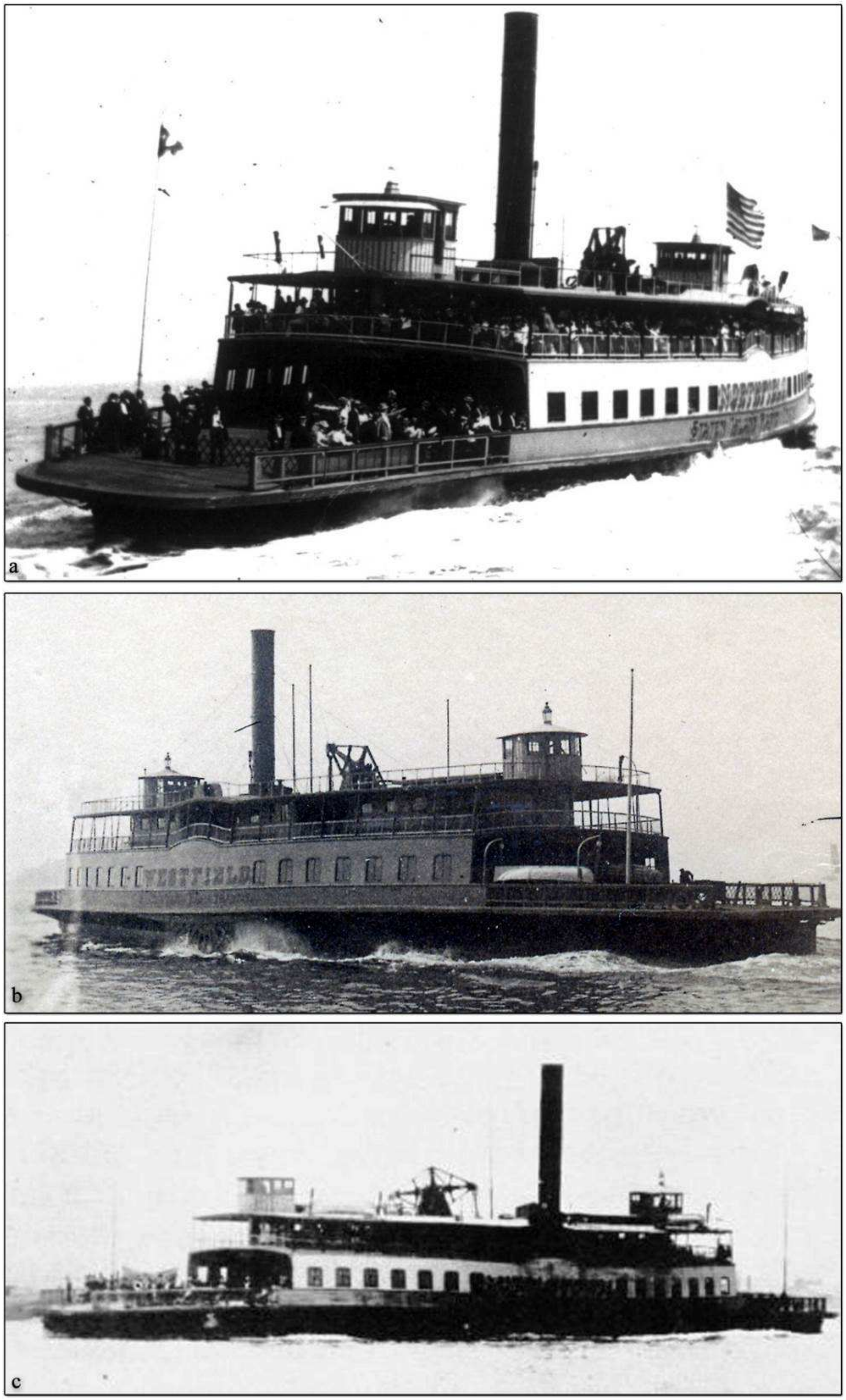


FIGURE 2. STATEN ISLAND FERRIES
A) *NORTHFIELD*, B) *WESTFIELD II (AFTER REBUILT)*, AND C) *MIDDLETOWN*
(IMAGES COURTESY OF TREVOR GHERARDI)

1903:269–271; Stiles 2009:105–107). It was built by Bishop and Simonson, a shipyard owned and operated by Joseph Bishop and Charles M. Simonson, the latter of whom was Vanderbilt's brother-in-law. Vanderbilt's company, Richmond Turnpike Ferry (later Staten Island & New York Ferry Co.), also introduced the earliest double-ended ferry on the Staten Island route, the 252-ton *Samson* in 1837 (Cudahy 1990:65–67). The Vanderbilt-operated freight and passenger services along the coast of New England, and particularly New York, became a lucrative venture in his early fortune. In 1862, Vanderbilt sold his maritime interests and began investing heavily in railroads (Cudahy 1990:66).

The construction of the ferry *Westfield* was an extension of Vanderbilt's shipbuilding legacy. Its prolific builder Jeremiah Simonson was the second child born to Cornelius Vanderbilt's older sister Mary and her husband Charles M. Simonson (of the Bishop and Simonson shipyard). Jeremiah Simonson's shipbuilding affiliation with Vanderbilt in later years was almost preordained; he was born in Cornelius Vanderbilt's Ferry House at Richmond, New York, in 1807 (MyFamily.com). Vanderbilt's first ferry, *Lexington*, was Simonson built, albeit by Bishop and Simonson of New York City. Bishop and Simonson produced steam vessels into the late 1840s, the last of which were built in 1848. Jeremiah Simonson inherited Bishop and Simonson and by 1849 was operating the company under his own name (*New York City Directory* 1848–1850; Stiles 2009:105). Jeremiah Simonson's irresponsible and luxurious spending habits forced the company into bankruptcy. Vanderbilt purchased Simonson's shipyard in 1849 and left it in the care of his nephew. Of at least 37 steamers that were produced by the Simonson shipyards (Table 2), including mail steamers, ferries, packets, and steam yachts, approximately 17 vessels were built explicitly for use in Vanderbilt's ferry and packet lines. *Vanderbilt* was the most widely known of Simonson's vessels, having originally been constructed as a transatlantic passenger and mail steamer. This vessel was given to the U.S. Navy by Vanderbilt in 1862. Other Vanderbilt-owned/Simonson-built steamers such as *Ariel, Northern Light,* and *Star of the West* were chartered by the government for the U.S. Navy (Kemble 1943:215, 245, 248). *Star of the West* gained notoriety on January 9, 1861, when she drew fire while approaching Forts Moultrie and Sumter. This is considered the first exchange of gunfire in the Civil War conflict (Malsch 1977:144; Scharf 1887:495). *Star of the West* was captured by the Confederate Navy as she lay at anchor off Indianola, Texas, on April 17, 1861 (Scharf 1887:495–497).

Jeremiah Simonson built seven ferries for the Staten Island & New York Ferry Company between 1852 and 1864: *Hunchback, Clifton, Clifton II, Northfield, Middletown, Westfield*, and *Westfield II* (Cudahy 1990:402–403). *Clifton II* and *Westfield II* were built in 1862 after their predecessors had been sold to the U.S. Navy. Simonson's ferries *Hunchback* and *Clifton II* (*Shokokon*) were also sold to the navy; *Westfield* and *Clifton* were lost in 1863 and 1864, respectively (Cotham 2006:130, 174, 175). *Hunchback*, the first vessel built by Simonson for the Staten Island Ferry (1852), was 179 ft long. This vessel was also the first two-deck ferryboat to work in New York harbor (Cudahy

Table 2. Simonson-Built Vessels

Vessel	Builder*	Location	Year	Tons	Dimensions	Engine Type	Engine Maker	Cylinder	Original Owner	Source
Lexington	B & S	New York, NY	1835	488	207' x 21' x 11'	Beam	West Point Foundry Co.	48” x 11'	Cornelius Vanderbilt	Heyl 1967:167
Nimrod	B & S	New York, NY	1835	432	175' x 20'8” x 8'	Beam	West Point Associates	40” x 8'	John Brooks	Heyl 1967:203
Cleopatra	B & S	New York, NY	1836	402	193' x 23' x 8'11”	Beam	West Point Foundry Co.	44” x 11'	Cornelius Vanderbilt	Heyl 1956:41
Osiris	B & S	New York, NY	1838	145	110'6” x 20' x 7'	Crosshead	James P. Allaire		James P. Allaire	Heyl 1956:189
Iolas	B & S	New York, NY	1842	180	121'4” x 20'10” x 7'7”	Beam (2)	Allaire Works	Two	James P. Allaire	Heyl 1964:181
Kennebec	B & S	New York, NY	1845	480	212' x 26'6” x 10'5”	Beam		41” x 11'	Menemon Sanford (Sanford's Independent Line)	Heyl 1956:123
Traveller	B & S	New York, NY	1845	584	225' x 29' x 9'6”	Beam	Allaire Works	52” x 11'	Cornelius Vanderbilt	Heyl 1964:323
Antelope	B & S	New York, NY	1846	1847	178'8” x 27'8” x 17'4”	Beam	T.F. Secor & Co.		New York Owners	Heyl 1953:27
Atlantic	B & S	New York, NY	1846	1112	320' x 36' x 9'10”	Beam	T.F. Secor & Co.	72' x 11”	Norwich & New London Steamboat Co.	Heyl 1964:21
Aurora	B & S	New York, NY	1846	337	155'9” x 24'5” x 10'	Injected direct-acting	Hogg & Delamater	40” x 8'	Unknown	Heyl 1967:19
Osprey	B & S	New York, NY	1846	400	144' x 26'7” x 7'2”	Steeple		59” x 6'	S. Mason	Heyl 1964:267
Commodore	B & S	New York, NY	1848	984	275' x 32' x 11'	Beam	Allaire Works	65” x 11”	New Jersey Steam Navigation Co.	Heyl 1964:95
Ohio	B & S	New York, NY	1848	2432	246' x 46' x 32'9”	Side-lever (2)	T.F. Secor & Co.	90” x 8'	U.S. Mail SS Co.	Heyl 1953:315
State of Maine	B & S	New York, NY	1848	806	236' x 32' x 11'	Beam	Allaire Works	54” x 11'	Penobscot Steam Navigation Co.	Heyl 1956:243
Prometheus	S	New York, NY	1850	1207	230'6” x 33' x 20'2”	Beam (2)		42” x 10'	Cornelius Vanderbilt	Kemble 1943:243
Northern Light	S	New York, NY	1851	1768	253'6” x 38'2” x 22'6”	Beam (2)	Allaire Iron Works	60” x 10'	Cornelius Vanderbilt	Kemble 1943:238; Heyl 1953:307
Hunchback	S	New York, NY	1852	517	179' x 29' x 10'6”	Beam		40” x 8'	Cornelius Vanderbilt	Heyl 1967:145
Star of the West	S	Greenpoint, NY	1852	1172	228'4” x 32'8” x 24'6”	Beam (2)	Allaire Iron Works	66” x 11'	Cornelius Vanderbilt (Independent Line)	Heyl 1953:413
North Star	S	Greenpoint, NY	1853	2004	262'6”“ x 38'6” x 28'	Double beam	Allaire Iron Works	60” x 10'	Cornelius Vanderbilt	Kemble 1943:237; Heyl 1953:303
Ariel	S	New York, NY	1854	1736	252'6” x 32'6” x 16'6”	Beam	Allaire Iron Works	75'“ x 12'	Cornelius Vanderbilt	Heyl 1953:33
Plymouth Rock	S	New York, NY	1854	1752	330'x x38' x 12'	Beam	Allaire Works	76” x 12'	Cornelius Vanderbilt	Heyl 1964:287
Granada	S	New York, NY	1855	1059	228' x 31' x 15'6”	Beam	Allaire Iron Works	65” x 10'	U.S. Mail SS Co.	Heyl 1953:191
Vanderbilt	S	New York, NY	1855	3360	331' x 48' x 32'	Beam (2)	Novelty Iron Works	80” x 12'	Cornelius Vanderbilt	Heyl 1953:435
Santiago de Cuba	S	New York, NY	1860	1567	229' x 38' x 19'	Beam	Neptune Iron Works	66” x 11'	Valiente & Co.	Heyl 1953:381
Clifton	S	Brooklyn, NY	1861	892	210' x 40' x 13'6”	Beam	Allaire Works	50” x 10'	Staten Island & New York Ferry Co.	Heyl 1965:47

Table 2 (Cont'd)

Vessel	Builder*	Location	Year	Tons	Dimensions	Engine Type	Engine Maker	Cylinder	Original Owner	Source
Westfield	S	Brooklyn, NY	1861	891	213'4" x 34' x 12'11"	Beam	Morgan Iron Works	50" x 10'	Cornelius Vanderbilt (Staten Island & New York Ferry Co.)	Heyl 1965:335
Clifton II	S	New York, NY	1862	709	181'7" x 32' x 13'6"	Beam	Allaire Iron Works	43" x 10'	Staten Island & New York Ferry Co.	Silverstone 2001:71
North America	S	Greenpoint, NY	1862	2985	252' x 37'6" x 27'10"	Beam	Allaire Iron Works	80" x 12'	Cornelius Vanderbilt	Heyl 1953:301
Westfield II	S	Brooklyn, NY	1862	609	202' x 32' x 13'	Beam		50" x 10'	Staten Island & New York Ferry Co.	Cudahy 1990:403
Costa Rica	S	New York, NY	1863	1197	269' x 38'10" x 27'	Beam	Allaire Iron Works	81" x 12'	Cornelius Vanderbilt	Heyl 1953:113
Northfield	S	Brooklyn, NY	1863	600	202' x 34' x 13'	Beam		50" x 10'	Staten Island & New York Ferry Co.	Cudahy 1990:403
Fort Jackson	S	Greenpoint, NY	1863	2085	252' x 37'6" x 27' 10"	Beam	Allaire Iron Works	80" x 12'	Cornelius Vanderbilt	Heyl 1953:151
Middletown	S	Brooklyn, NY	1864	641	201' x 33' x 14'	Beam		50" x 10'	Staten Island & New York Ferry Co.	Cudahy 1990:403
New York	S	Greenpoint, NY	1864	2217	292'6" x 477" x 26'6"	6-cylinder beam	Allaire Iron Works (Morgan?)	78" x 12'	Cornelius Vanderbilt	Kemble 1943:237; Heyl 1953:295
Nevada	S	Brooklyn, NY	1865	2144	281' x 40/ x 16.3'	Beam	Morgan Iron Works	85" x 12'	Thomas W. Dearborn	Kemble 1943:235; Heyl 1953:287
Grampus	S	New York, NY	1866		253' x 40' s 15'	Beam	Fletcher, Harrison & Co.	62" x 12'	Capt. Willam P. Williams	Heyl 1967:259
Walrus	S	New York, NY	1866	1633	253' x 40' x 15'	Beam	Delamater Iron Works	62" x 12'	New York & Philadelphia Steamboat Co.	Heyl 1965: 327

* B&S is Bishop and Simonson; S is Jeremiah Simonson.

1990:49). Staten Island ferries built by Simonson in 1861 and 1862 were between 210 and 213 ft in length (LWL). Simonson's last Staten Island ferryboats, *Westfield II*, *Northfield*, and *Middletown*, built between 1862 and 1864, were all approximately 200 ft long. *Westfield II* was heavily damaged on July 30, 1871, when the boiler exploded as she was docked at her slip at the end of Whitehall Street. Accounts of the accident attest to between 66 to 93 deaths, and twice as many suffered

severe or disfiguring injuries (*Harper's Weekly* 1871; *New York Times* 1904:6; Stiles 2009:514). This tragedy is considered the greatest disaster in the history of the Staten Island Ferry. *Westfield II* was repaired and, by the time of its retirement in 1905, held the record for the longest service tenure in the fleet at 44 years (Scull 1982:10).

Westfield's low-pressure walking beam engine was built by Morgan Iron Works, in New York City. The one-cycle, 50-inch-x-10-ft engine was like those produced for *Northfield*, *Clifton*, *Westfield II*, and *Southfield II*. Morgan Iron Works evolved from a partnership formed between Charles Morgan, later of Morgan Lines, and Theodosius F. Secor in 1836. In 1838 Secor sold his interest in the company to Morgan who founded Morgan Iron Works (*New York Times* 1901:9). Morgan Irons Works was considered preeminent in its field as a manufacturer of engines, boilers, and machinery for steamships in both the mercantile fleet and naval service (*New York Times* 1891:9–16). By the time of its closure in 1903, Morgan Iron Works had outlasted the other great New York engine manufacturers of its day such as Allaire Iron Works, Novelty Iron Works, Fulton, and Neptune. These companies were no longer in operation in 1881 (*Chester Daily News* 1881:3). Morgan Iron Works was forced to close in 1903 following a destructive fire and continued problems with the union labor movement (*New York Times* 1903:1). Morgan Iron Works manufactured engines of at least five of the Simonson vessels; over half of the engines used in these vessels were produced by Allaire Iron Works (see Table 2).

Military Conversion

Westfield's career as a Staten Island ferry was short lived, as she was purchased by the U.S. Navy in late November, only 5 months after her official enrollment on July 19, 1861 (Heyl 1965:335). USS *Westfield* was one of a select few ferries incorporated in the U.S. Navy during the Civil War. Twenty ferryboats were converted to military service by the U.S. Navy, and five of these were of Cornelius Vanderbilt's Staten Island & New York Ferry Company. This is a very small portion (ferries at 2 percent, Staten Island ferries at 0.4 percent) of the 1,024 active-duty vessels engaged in Union service by the end of the Civil War (Minick 1962:436).

On April 17, 1861, Jefferson Davis incited a naval arms race with the declaration that he would issue letters of marque, thus enabling Confederate interests to prey upon Union shipping (Scharf 1887:53). Union strategists immediately set about creating a blockading force as a means to quell the new threat on northern maritime commerce. The Union navy was not prepared to undertake a task of such large proportions. Of the 90 vessels in the fleet, only 41 were serviceable, and a large portion of these were stationed abroad. The newly mandated blockade was enforced by a naval squadron consisting of no more than seven steamers, five sailing ships, and a tender; four of these vessels were currently on their return from Vera Cruz (Underwood 2003:27).

Originally the task of purchasing vessels for the navy was allotted to navy personnel, though this was discovered to be costly and countereffective. Naval captains unfamiliar with purchasing civilian watercraft were being taken advantage of by opportunistic owners eager to sell their vessels at inflated costs. The Secretary of the Navy, Gideon Welles, appointed his brother-in-law, George D. Morgan, to acquire vessels in New York for the navy. Morgan arranged for the appropriation of 89 vessels for the Union (Fowler 1990:52) including *Westfield*, which was purchased from Cornelius Vanderbilt for $90,000 on November 27, 1861 (Appendix A-1).

Almost two dozen New York ferries were acquired by the U.S. Navy. The advantages of the ferry design were numerous. The New York ferries were shallow-draft vessels with decks designed for heavy burdens, and they were double-ended ships capable of steaming with equal facility in either direction. These design features enabled the armed and converted ferries to navigate shallow, sometimes confining, waterways and carry heavy loads such as artillery (Fowler 1990:53). They had a wheel house and rudder on each end, and their exterior hulls were completely symmetrical fore and aft. The bow was distinguished from the stern in use, no doubt to facilitate communication among the officers and crew. The smoke stack and boilers were positioned forward of the paddle wheel, walking beam and engine, and anchors were positioned at the bow.

By the time George Morgan reviewed *Westfield*, he had already acquired several ferries for the navy. On November 7, 1861, after *Westfield* had been examined by a board of officers, Morgan recommended the Navy purchase *Westfield*. The ferry was described as "1100 tons, iron strapped, coppered, has been built this summer, perfect in every respect, carries 4000 troops . . . a thorough seaboat . . . she is perhaps the best boat in the harbor" (Morgan 1861a). Just 2 days later on November 9, Morgan discussed the purchase of *Westfield* for $90,000 and added that she has "iron wheels, coppered, well adapted to sea service . . . she is new and in fine order" (Morgan 1861b). *Westfield* was quickly acquired.

The conversion and outfitting of *Westfield* for military service was completed by Jacob A. Westervelt of New York City for the cost of $27,500 (Mariners' Museum n.d.). Westervelt, a well-known New York shipbuilder, was also responsible for the conversion of the steamer *Clifton*. Westervelt also served as mayor of New York City from 1853 to 1855 and later as Dock Commissioner (*Daily Constitution* 1879; Schemmel 1995). Westervelt was not the original choice for the task of converting *Westfield*. George Morgan was communicating with the firm Copeland and Howe whom he favored for the job.

Copeland and Howe was operated by James Howe and Charles W. Copeland, the latter of whom was on George Morgan's board of officers. Morgan recommended Copeland and Howe to Gustavus Fox, Assistant Secretary of the U.S. Navy, in a letter on November 11, 1861 (Morgan 1861c). Copeland and Howe submitted a proposal that covered the work and cost of outfitting the ferry *Westfield* as a gunboat. This proposal, transcribed below, was sent to Rear Admiral Hiram Paulding, the Commandant of the New York Navy Yard, on November 11, 1861 (Copeland and Howe 1861a). The content of the Copeland and Howe *Westfield* proposal is almost identical to an earlier version they submitted for refitting of *John P. Jackson* (Copeland and Howe 1861b) and also one submitted on July 16, 1861, for the steamers *Whitehall* and *Ellen* (Minick 1962:428–439). No documentation for the work performed by Westervelt has been discovered in the National Archive repositories in Washington and New York. In absence of this documentation, the contents of the Copeland and Howe proposal is transcribed below as it provides the best approximation of the work that may have been performed on the steamer.

On November 15, Copeland and Howe amended the proposals for *Westfield* and *John P. Jackson* and reduced the total cost for altering *Westfield* to $29,400 (Copeland and Howe 1861c). Copeland also arranged to have the gun carriages for the ferries to be manufactured in Baltimore by Mr. Rowland (Copeland 1861). Presumably, Copeland and Howe's amended proposal did not meet the satisfaction of the navy; on November 16 Admiral Paulding ordered work on *John P. Jackson* to be undertaken by Mr. Westervelt (Lenthall 1861a). By November 18, 1861, the work for *Westfield* and the recently purchased *Clifton* was still unresolved. Morgan sent a letter to Augustus Fox pressuring him to make a decision, though ultimately, on November 22, Mr. Westervelt was selected to do the work on *Westfield*. Lenthall suggested Copeland and Howe for *Clifton* if they could be hired for the same cost (Lenthall 1861b; Morgan 1861d). The disagreement between Morgan and the navy yard over shipbuilders appears to have been related primarily to the cost of work. On November 22, Morgan suggested Copeland and Howe fit out *Clifton*, "being exactly like *Westfield*" for the sum of $25,000 requested by Augustus Fox. Morgan also recommended offering the work to Jeremiah Simonson, *Clifton*'s builder, if Copeland and Howe declined (Morgan 1861e). On November 23, Morgan was still encouraging Fox to give the work to Copeland and Howe (Morgan 1861f). Two days later on November 25, Fox authorized Morgan to give the *Westfield* work to Copeland and Howe if Mr. Delano had not already given the work to Westervelt (Morgan 1861g). The conversion of the ferries was supervised by the New York Navy Yard, though performed by privately owned shipbuilding companies. At the time of *Westfield*'s refitting, however, the navy yard was unable to oversee Westervelt's work, and Mr. Hart was recommended for the task (Morgan 1861h).

Though the Westervelt proposal has not been found, it is likely very similar to that of the Copeland and Howe proposal, especially as these were written to conform to specific New York Navy Yard requirements. A sketch made of *Westfield* in December 1862 (Figure 3) is, so far, the only identified depiction of the steamer rendered by an eyewitness of the vessel. The drawing is in the collection of the Memphis and Shelby County Room at the Memphis Public Library and Information Center. It was authenticated by Edward Cotham Jr., a Civil War naval historian, in 2001 (personal communication Edward Cotham). Two other drawings from the same Memphis Library collection,

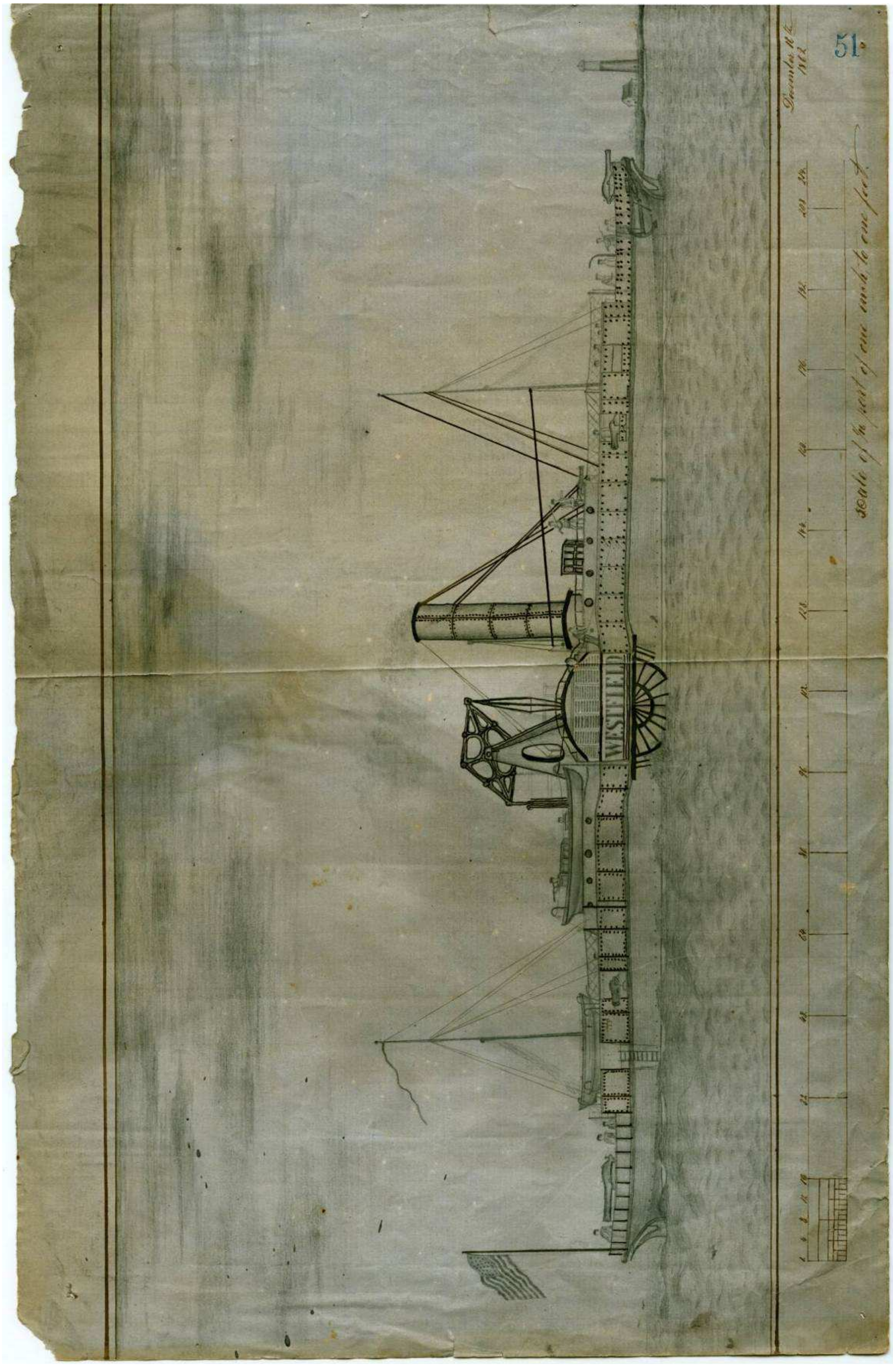


FIGURE 3. 1862 SKETCH OF *WESTFIELD* (IMAGE PROVIDED COURTESY OF THE MEMPHIS AND SHELBY COUNTY ROOM, MEMPHIS PUBLIC LIBRARY AND INFORMATION CENTER)

(Copy)

Brooklyn Nov 11, 1861

Com H. Paulding
Com Navy Yard
Brooklyn N.Y.

Sir,

By request of the Asst Secretary of the Navy, we submit a proposal to alter and fit up the steamboat "Westfield" for service as a steamboat in the manner proposed by the Board of Officers directed to examine her, viz Reduce the guards and post under sponsons their whole length-put up bulwarks five feet in height, four broadside ports on each side, the iron bulwarks at ends to drop down for the range of pivot guns. The deck to be sheathed, the ends of oak or yellow pine for gun beds. The promenade deck to be dropped down 7 or 8 feet of main deck. Accommodations for officers and men to be arranged on deck similar to steamer Helen and Whitehall. New pilot houses & steering arrangements. Capstan, hause pipes & chain lockers to be fitted. Two boats each 28 feet long with cranes, falls & completely fitted. Two magazines with shot & shell lockers one at each end of the boat. Berth deck to be put in at each end of boat, with required hatches and ladders. Fine state rooms to be put up on berth deck aft. Coal bunkers & store rooms fitted below. Additional beams and knees to deck. Engine and boiler put in good order. Protecting case around steam drum. Necessary valves and fittings. Two additional hand bilge pumps of satisfactory dimensions & to be furnished and fitted.

Vessel to be docked and caulked, an additional strake of yellow metal put on. The necessary breeching ring, eye bolts for guns, put on. Fit up kitchen with camboose & appurtenances. Tiller to be fitted with proper relief tackles for steering on main deck. Also two riding bitts and the necessary deck cleats. Also complete the ceiling of the sides of the boat 2 ½ inch oak planks butt bolted. The whole for the sum of twenty-seven thousand [marked out word] hundred & seventy five dollars.

We also propose to cover the bulwarks with iron plating the whole length of the boat with hinges and fastenings complete, similar to the steamboat Helen for the sum of twenty-eight hundred and eighty dollars. Also furnish one anchor of about 1950 and one anchor of about 950 and 90 fathoms of ?/8 chain and ninety (90) fathoms of 1 5/8 chain for five hundred and ninety two dollars. The whole to be completed and ready for the outfit & armament to the satisfaction of the officers directing the work. As with the other boat, the old materials to belong to us & to be used in the alterations as far as practicable.

Chars W. Copeland
By James Howe

James Howe

Steamboat Westfield is 223 ft long, 40 ft beam, 13 6/12 ft hold about 1000 tons.

one showing the Ram *Manassas* and the other the Ram *Louisiana*, have nearly identical handwriting suggesting that all three were drawn by the same individual. The vantage point for the *Manassas* drawing, stated in the caption, implies that the artist was among the crew of *Harriet Lane.* Based on the vantage point of the *Westfield* sketch, the artist may have been stationed temporarily at the former Confederate barracks on Pelican Spit when Figure 3 was drawn.

The sketch of *Westfield* indicates that many key components of the Copeland and Howe proposal had been adopted. *Westfield*'s upper saloon deck was removed/lowered, and new pilot/wheelhouses were built at the lower level. Iron-plated bulkheads 5 ft in height were constructed, and the gun decks had the requisite hinged protective plating. Other details, not mentioned by Copeland and Howe, include a reduced number of windows now depicted as portholes, a vented paddle-box, and visible external paddle walks (indicated by the figure standing upon them). Prior to the height reduction, *Westfield* contained covered foyers just forward and aft of the main cabin. When the cabin was lowered, the roof over the foyers was removed exposing these areas, and creating more space for the guns decks. Rather than rebuilding the ends of the paddlewheel box, which would have become open following the height reduction, the shipyard instead left the original box intact. This required leaving small portions of the original deck height. The artist depicts these portions as a small step on either side of the box.

Figure 3 suggests at first glance that *Westfield*'s paddlewheel box after conversion projected outward from the vessel, indicating a reduction in the vessel's guards. While this aspect was proposed in the Copeland and Howe document, upon closer examination of the drawing, this does not appear to be the case. Instead, the artist may have misunderstood what he was seeing and drew the paddlewheels as he understood them to be on *Harriet Lane*, a vessel without guards. On oceangoing sidewheelers with overhanging guards, it was very common to enclose the sponsons with planks to prevent them from being ripped from the vessel while in rough waters (Whittier 1983:27). The artist drew two types of hull planking. On the lowest portion of the drawing, the planks follow the keel, as would be expected. But above this, a series of dots marks where the sponsons should be. A second type of planking follows these dots and curves upward at the bow and stern, leaving a distinct line between the two types of planking. At the paddlewheel box, the planking curves sharply inwards, where four sponsons still exist, two on each side of the box (Figure 3). Rather than heavily altering the guards, *Westfield*'s sponsons were instead planked over creating a large hull blister on each side of the paddlewheel. This modification is also evident on the converted ferryboats *Commodore Perry* and *Commodore McDonough*.

Witnesses were interviewed by the Confederate States Prize Commission for a series of interrogatories related to the vessel's salvage (see Appendix A-2). The interrogatories agree that *Westfield* was single-decked, though the number and type of guns vary in the accounts. Daniel Phillips additionally described "two king posts on which were erected staffs for setting signals – She carried four quarter boats, anchors (2) and two chains, and the usual amount of tackle and furniture usually carried by vessels of her class" (Appendix A-2, Letter 8). In some of the accounts, the signal posts have mistakenly caused the boat to be described as schooner rigged (Appendix A-2, letters 4 and 9).

George Grover, the mayor of Galveston at the time of *Westfield*'s destruction, described an additional system of protection for *Westfield*: "From the wheelhouse forward as well as aft she had wooden curtains cased within iron which could be raised or depressed at pleasure–displaying no portholes" (Appendix A-2, Letter 9). Though this passage was originally interpreted as suggesting the vessel indeed had portholes, the description of the "portholes" as fore and aft of the wheelhouses suggests he was discussing the area of the fore and aft gun decks. Grover was likely describing the gun ports.

According to the Memphis drawing, *Westfield* had at least twelve 5-x-5-ft metal plates along each side of the main cabin, in addition to the hinged plates along the gun decks. An example of the use of hinged plates is seen on Figure 4. The innovation of plating ships with iron was not a development of Civil War shipbuilding advances, but was likely inspired by the launch of the first ironclad battleship, *La Gloire*, by the French Navy in November 1859 (Murray 1863:26). A review of letters produced by the U.S. Bureau of Construction indicates many vessels were candidates for iron plating and included not just the ironclads and ferry-gunboats. For example, the 263-ft steam frigate *Roanoke* was converted to ironclad by plating the exterior of the vessel. The thickness of the plates was recommended as 2¼ inches at the deck and 5½ inches on the outer hull from the waterline to the deck (Lenthall 1862a). The 237-ft wooden-hulled screw sloop-of–war *Ticonderoga* was also suggested to be plated with iron though this was not carried through to completion. The iron plates were to be 4 inches thick along the sides and 1¼ inches thick at the deck (Lenthall 1862b).

Many of the converted sidewheel ferries were indeed plated. On some, the pilothouses were plated as well. The appearance of the plated, altered ferryboats may have confused those unfamiliar with the vessels. The officers of *Commodore Hull* believed their gunboat-ferry had been mistaken for an ironclad while anchored in New York Harbor (Minick 1962:427). J. Thomas Scharf, in his *History of the Confederate States Navy*, similarly describes *Westfield* as an ironclad, repeating the error (Scharf 1887:506).

Other U.S. Navy ferry-gunboats such as *Whitehall*, *Ellen*, *Morris*, *Commodore Barney*, and *Commodore Perry* were likewise reinforced with plating, though *Commodore Perry* may be the only of these aforementioned vessels plated along its entire length (Minick 1962). The smaller 2-x-3-ft plates at the bow and stern of *Westfield* (the 1862 Memphis sketch; see Figure 3) suggest the smaller iron "hinged" plates from the gun decks of *Morris, Satellite* (a converted tugboat), and *Commodore Perry* (see figures 4, 5, and 6). These vessels employed a type of hinged metal plating that could be raised or lowered at discretion to facilitate use of the cannon. A photograph of *Commodore Perry*'s deck shows the treatment of the enclosed deck cabin (Figure 7).

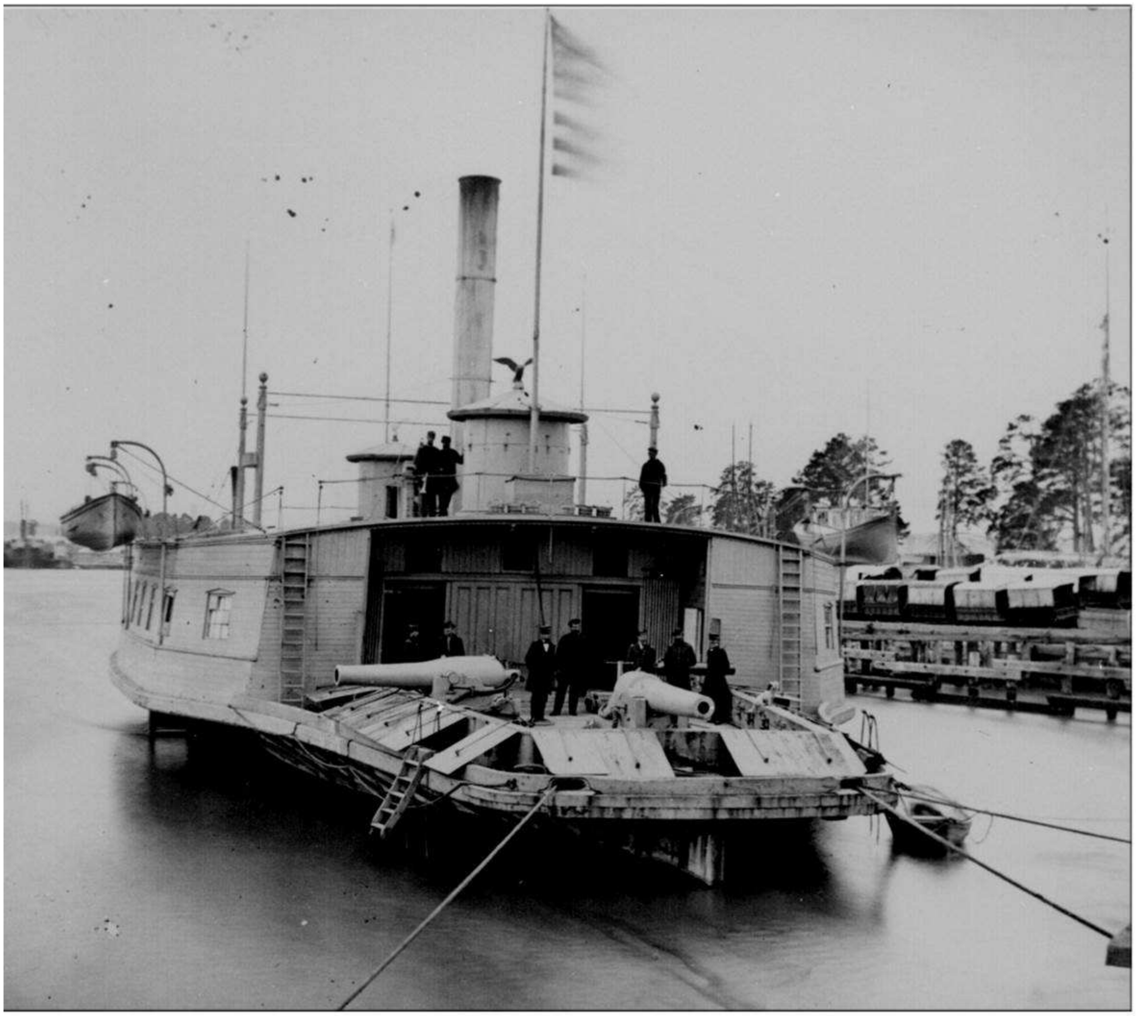


FIGURE 4. USS *MORRIS* CA. 1860–1861
(PHOTO OFTEN MISIDENTIFIED AS THE USS *COMMODORE PERRY*)
(NATIONAL ARCHIVES, MATHEW BRADY COLLECTION, ARC NO. 524831)

Details of the new deck arrangement for the converted gunboats are discernible in photographs of USS *Hunchback*, Simonson's first two-decked Staten Island ferry. Historic images by Mathew Brady show the vessel prior to and following her conversion as a gunboat (Figure 8). The upper promenade/saloon deck has been removed. The deck cabin, formerly open, has been enclosed, possibly similar to the treatment of USS *Morris*. The newly enclosed deck, hinged plating, boat davits, and two of the deck guns, a Parrott rifle and Dahlgren, are all visible in the photograph of *Morris* (see Figure 4). Sections of the deck cabin on *Commodore Hull*, for example, were compartmentalized to include officers' quarters, storerooms, and galleys (Minick 1962:427).

The advantages of the plated ferry-gunboats inspired the New York Navy Yard to consider contracting for the construction of one or two purpose-made iron-plated gunboats that were double ended in the "ferry boat style." A request for proposals, complete with accompanying vessel

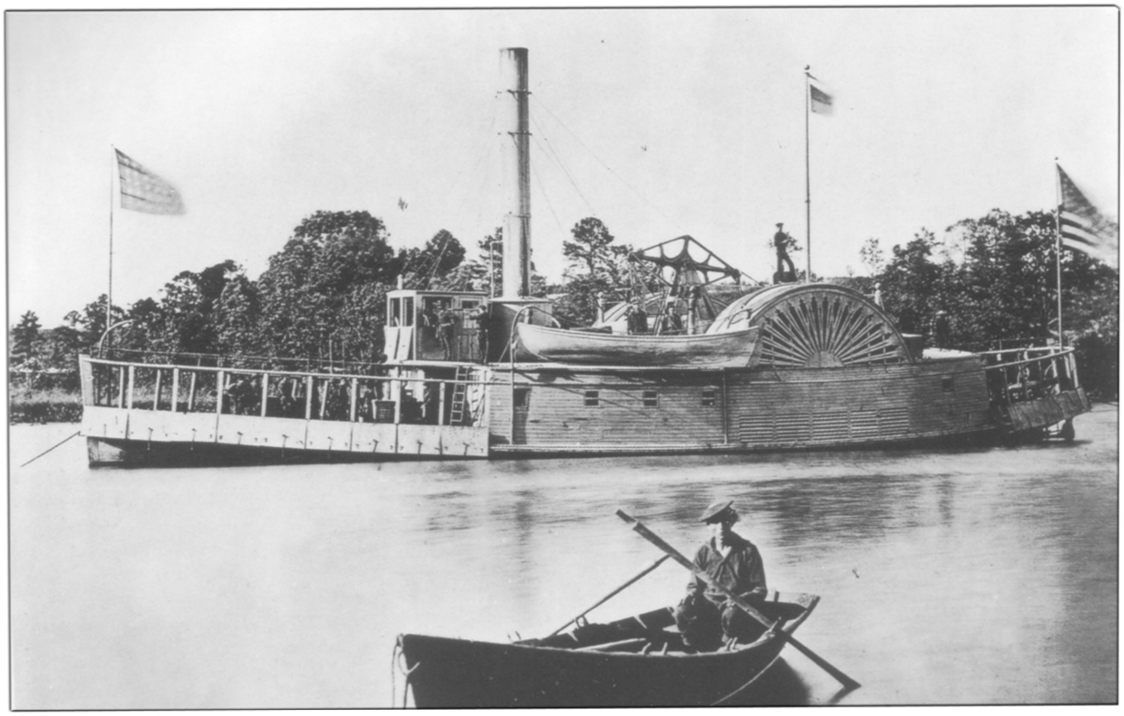


FIGURE 5 (TOP). POSSIBLY USS *SATELLITE* CA. 1860–1865 (COWAN 2012)
(NATIONAL ARCHIVES, MATHEW BRADY COLLECTION, ARC NO. 524601)

FIGURE 6 (BOTTOM). USS *COMMODORE PERRY* IN 1863
(NATIONAL ARCHIVES, MATHEW BRADY COLLECTION, ARC NO. 524850)

FIGURE 7. DECK OF *COMMODORE PERRY* CA. 1860–1865 (NATIONAL ARCHIVES, MATHEW BRADY COLLECTION, ARC NO. 524570)

specifications, was written in May 1862 (U.S. Navy Department 1862). Proposed to have dimensions of 212 (keel length) x 34.5 x 13 ft, such vessels would have been nearly identical in size to *Westfield*, were conceived to carry a similar size crew (120 vs. *Westfield*'s 130), and like *Westfield*, were to be outfitted with six cannon. The main difference between the proposed purpose-made plated "ferry style" gunboats and the converted *Westfield/Clifton* was in the engine (lever or inclined engine vs. walking beam).

The list of specifications for construction of "ferry style" gunboats is 25 pages in length and provides a glimpse of the types of details that might have been part of *Westfield*'s design. The 88-ft-long promenade deck (the enclosed area on the main deck) was to be 9 ft in height with pilothouses projecting 3 ft above the deck. Incidentally, the scaled 1862 sketch of *Westfield* (see Figure 3) depicts the promenade deck as 90 ft in length with a height of 8.5 ft. The pilothouses are 4.25 ft in height. The keel of the newly proposed vessels was to be made of white oak 14-inch sided, with center keelsons of white pine 14 x 14 inches. The engine keelsons were to be 20-inch sided and 48 inches in height and fastened with two 1¼-inch-diameter screw bolts in each timber. The outer hull

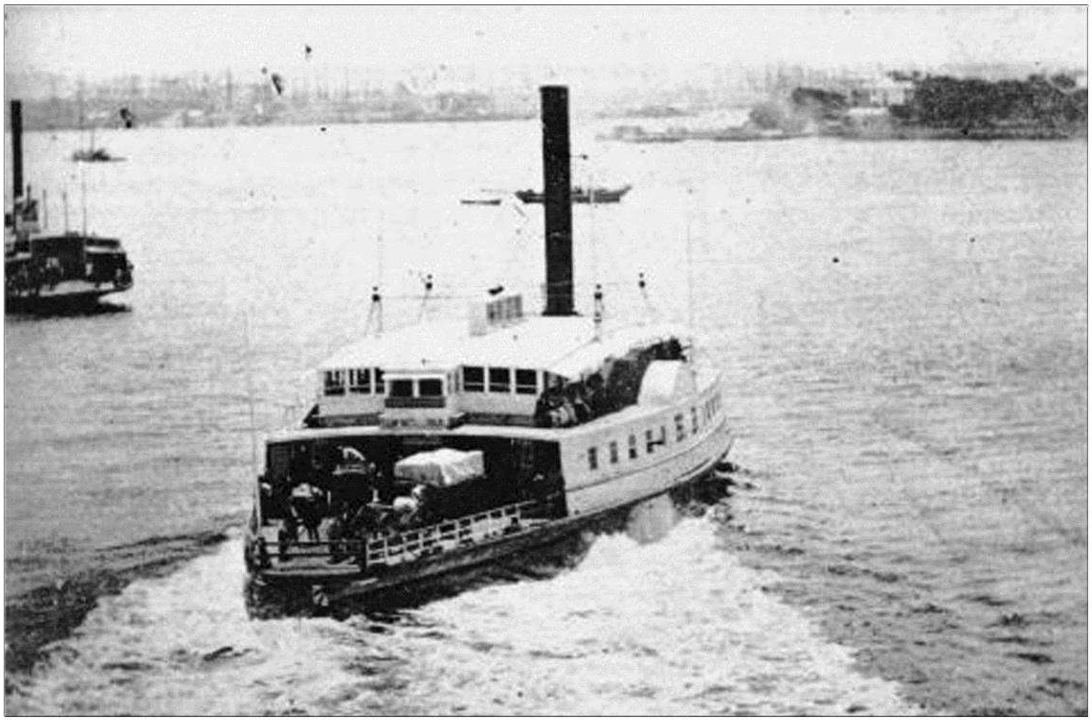


FIGURE 8. USS *HUNCHBACK* IN 1859 BEFORE CONVERSION (TOP)
(IMAGE COURTESY OF TREVOR GHERARDI) AND IN CA. 1860–1865 AFTER CONVERSION (BOTTOM)
(NATIONAL ARCHIVES, MATHEW BRADY COLLECTION ARC NO. 526207)

planking was to be of 3-inch-thick square fastened white oak and the deck planking was to be of 3-inch white pine in strakes no wider than 5 inches. The deck planks were to be attached to the deck beams with 5½-inch spikes. The gangway of each vessel was to have a second layer of decking of either white oak or pine, of 2 inch thickness, fastened with 4½-inch spikes. The berth deck was to be constructed under the main deck, fore and aft of the engine and boilers, with a height of 5 ft. Two 12-ft magazines and 5-ft shell lockers (a pair both fore and aft that were the width of the hold) and the (anchor) chain lockers were to be constructed below the berth deck and in the hold. The rudders were to be 3½ to 4 ft in width.

The vessels were to have a 50-inch-diameter-x-10-ft stroke engine (same configuration as *Westfield*); paddlewheels 22 ft in diameter and 8½ ft wide; two return flue boilers 9¼ ft in diameter x 24 ft in length; a steam pump equivalent to a Worthington No. 5; a fresh water condenser; two 5-ft-diameter water tanks 20 ft in length; and a 60-inch-diameter steam chimney of 32 ft height. The engine room flooring was to be composed of cast iron plates upon a brick and cement bed laid atop a plank platform. Other details outlined by the U.S. Navy included an 80-pound ship's bell; a coal bunker on each side on the engine/boilers; an engine room "house" on the main deck measuring 8 x 74 ft with semicircular ends; 11 windows on each side made of strong glazed glass (5 forward, 6 aft); and the outside of the boat was to be painted lead color and finished with a coat of black paint. The boilers, steam chimney, and steam pipe were also to be covered with a 1¼-inch-thick layer of hair and wool felt (U.S. Navy Department 1862). The felt, sometimes also referred to as "Brady's Shot Proof Compressed Hair," was perceived to protect boilers and engines from musket fire (Isherwood 1863).

The U.S. Navy discussed construction of these vessels with Cornelius Vanderbilt and Copeland and Howe soon after the purchase of *Westfield* and *Clifton*. Vanderbilt originally offered to build one or two of these gunboats at a cost of $110 a ton, though by December 9, 1861, he had decided against the venture (Morgan 1861i). Copeland and Howe offered to build the plated ferry gunboats at $120 a ton (Morgan 1861j). Vanderbilt's early involvement in conceptualizing and potentially building these vessels could very well indicate they were modeled after *Westfield* and *Clifton*. The ferry gunboats were favored among the vessels acquired in New York. In July 1862, the Bureau of Construction and Repair at the New York Navy Yard requested that if "there are any new ferry boats similar to those hencefore purchased that can be had at a fair value, the Department would be glad to know it" (Lenthall 1862c).

Concurrent with the conversion and outfitting of *Westfield* was the U.S. Navy initiative to recruit boat crews. On December 23, 1861, the U.S. Navy issued a general order requesting volunteers. Each volunteer, after passing a surgeon's examination and providing proof of residency, would be provided "one pea jacket, one pair blue cloth trowsers, one blue flannel overshirt, two under flannel shirts, two pairs woolen drawers, one mattress, two blankets, one seamless cap, and one black silk handkerchief" (Welles 1861). The pay for lower level enlisted men varied from $12 to $14 a month with petty officers receiving higher salaries of $20 to $25 (Welles 1861). The assignment of officers and crew to *Westfield* began sometime in January 1862. The request to assign three Acting Masters and three Acting Master's Mates was made by Gideon Welles, Secretary of the Navy, on January 30 (Welles 1862a). The overall crew compliment for both *Westfield* and *Clifton* was outlined in a letter to Rear-Admiral Hiram Paulding, Commandant of the New York Navy Yard, on February 3. Each vessel was to receive exactly the same crew allotment including 20 landsman, 18 seaman, 16 ordinary seaman, 12 firemen, 10 privates, 10 coal heavers, a cook, carpenter, sail maker, surgeon, and armorer. The total crew for each vessel was 130 (Welles 1862b [Appendix A-4]). Acting Assistant Paymaster Charles C. Walden was assigned to *Westfield*'s crew on February 5 (Paulding 1862a). On February 12, it was requested that one of the Acting Midshipmen from the steamer *Lawrence* was to be reassigned to *Westfield* and one also to *Clifton* (Paulding 1862b).

A week prior to her departure from New York, on February 15, 1862, *Westfield* was outfitted with a battery of six guns consisting of a 100-pounder Parrott rifle and a 9-inch Dahlgren (Figure 9), plus four 8-inch smoothbore 55 cwt. cannons (Minick 1962; Silverstone 2001:72). There are many discrepancies in the accounts of *Westfield*'s armament. Several sources have erroneously described *Westfield*'s guns as variably consisting of Columbiads, a 50-pounder Parrot rifle, a 30-pounder Parrot rifle, multiple 32-pounder 57 cwt. cannons, an 11-inch gun, and 8-inch Dahlgren cannons (Table 3). Often, these observations were presented by individuals onshore who were describing the armament from a distance, from aboard other vessels, from memory, or from hearsay. The ambiguity and inconsistency of such accounts have caused some writers to mistakenly conclude her entire armament was changed during her military career (Bell 1863a; Heyl 1965:336).

The compliment of cannon carried by *Westfield* did change in late 1862. The Parrott gun burst on November 2 during the bombardment of Port Lavaca, Texas in Matagorda Bay (Cotham 2006:114). While awaiting a replacement rifled gun, an additional 9-inch Dahlgren was brought aboard *Westfield* from *Clifton* on December 11. Almost 2 weeks later, on December 28, the new long-range gun, in the form of a "long 32" rifled gun, was received (Cotham 2006:127). Daniel Philips, a Confederate prisoner and one of the last men onboard USS *Westfield* before her sinking, reported on the location of *Westfield*'s final armament (Appendix A-2, Letter 8). "Her armament consisted of four eight inch guns on her fore castle – Two nine inch guns on her quarter deck – one rifle thirty two (rifled) shifting gun" (Appendix A-2, Letter 8). With the exception of the changes that were implemented in the weeks prior to *Westfield*'s destruction, Philips' statements concur with the list of her original armament. All artillery guns except for one of the 9-inch Dahlgrens was salvaged by the Confederacy.

One additional faux cannon was placed on the vessel after the capture of Galveston. On October 9, 1862, the crew of *Westfield* mounted a Quaker gun on the vessel's hurricane deck (as seen in Figure 3). The majority of the imposing weapons of the batteries in and around Galveston were Quakers, or logs carved and painted to look like cannon. This "cannon," was one of two that were captured from a Confederate battery on Pelican Spit. Renshaw described the Quaker guns as "full sized X-inch

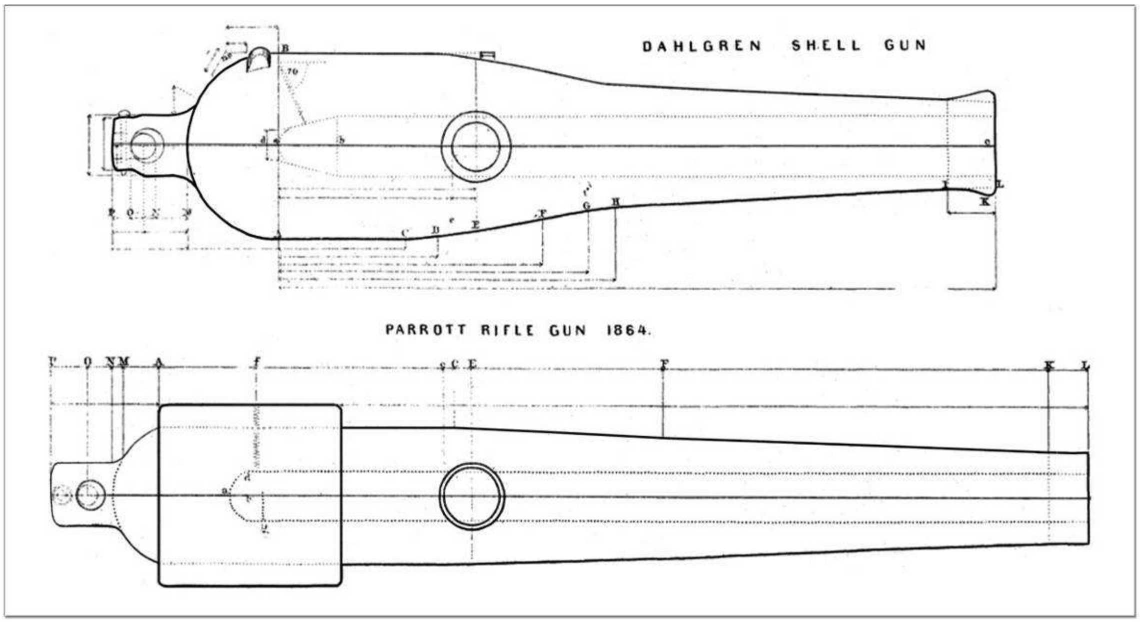


FIGURE 9. DAHLGREN SHELL GUN AND PARROTT RIFLE GUN

Columbiad, beautifully made and finished so perfectly that at twenty-five yards you couldn't tell them from guns of approved pattern." The second Quaker gun was to be mounted on the topgallant forecastle of *Owasco* (Renshaw 1862a). The use of wooden guns to trick enemy combatants is historically well documented (dating back to at least the sixteenth century). This practice was attested to in Galveston Bay at both Pelican Spit and at the harbor entrance (Blackmore 1976:11; Cotham 2004:33, 42, 2006:106). Gusley, a marine assigned to *Westfield*, felt that the wooden gun's new placement was especially fitting, as Galveston's Quaker guns had intimidated the blocking squadron for a year (Gusley 1862, in Cotham 2006:106). The reverse subterfuge apparently worked. Some Confederate accounts of *Westfield*, relating to her final days at Galveston in December 1862, described her armament as consisting of eight guns, which would have included the Quaker gun (*Houston Tri-Weekly Telegraph* 1863a; Hunter 1863; Magruder 1863a [see Table 3]).

Discussion of *Westfield*'s conversion would not be complete without recognizing the historical images of the vessel that have been reproduced in publications such as *Harper's Weekly*, *Frank Leslie's Illustrated History of the Civil War*, and a frequently published (though incorrect) example created by R.G. Skerrett in 1904 (Figure 10a). It is common in contemporary depictions of *Westfield*'s Civil War activities to see the gunboat depicted as a ferry superimposed into a battle or military scene. This may be most notable in an engraving of Porter's Mortar Flotilla entering the Mississippi River. The image was based on a sketch made by an officer of USS *Mississippi* and published in *Harpers Weekly* on May 17, 1862 (*Harper's Weekly* 1862a) (Figure 10b). Another illustration of *Westfield* by Julian O. Davidson, published in the *Century Illustrated Monthly Magazine* (1885), recreates the bombardment of Fort Jackson by Porter's Mortar Flotilla. In this depiction,

Table 3. Reported Gun Batteries of USS *Westfield*

Source	Total arms	ARMAMENT 100 pdr. Parrott	100 pdr. rifled	50 pdr. rifled	30 pdr. Parrott	32 pdr. rifled	32 pdr. SB 57 cwt	6-inch rifled gun	Large pivot gun	9-inch Dahlgren SB	9-inch gun SB	8-inch Dahlgren SB	8-inch Columbiads	8-inch gun	Other large guns	Quaker gun
Bell 1863b	6	1								1		4				
Bell 1863c	7			1			4				2					
U.S. Department of the Navy n.d.	6	1								1		4				
Appendix A-2, Letter 9, 1863	7															1
Gusley 1862, 1863*		1				1 (Long)				2						1
Appendix A-2, Letter 10, 1863	6							1		1				4		
Houston Tri-Weekly Telegraph 1863a	7			1			4			2						
Houston Tri-Weekly Telegraph 1863b	8															
Hunter 1863	8															
Appendix A-2, Letter 6, 1863**	3								1						2	
Magruder 1863a	8															
Minick 1962:435	6	1								1				4 (55 cwt)		
Naval Historical Center n.d.	6	1								1				4 (55 cwt)		
Appendix A-2, Letter 8, 1863	7					1					2			4		
Scharf 1887:506	9															
Scharf 1887:509	8															
Silverstone 2001:72	6		1								1			4 (55 cwt)		
Appendix A-2, Letter 4, 1863	11															
Soley 1898	6		1								1			4 (56 cwt.)		
Dana 1864					1											
Appendix A-2, Letter 14, 1863											1			3 (68 pdr)		
The Haverhill Sunday Record 1927	6	1									1			4		
Appendix B, Letter 7, 1863	6							1		1			4			

*From Cotham 2006:106, 107, 124, 127.

**Source does not remember other guns on the vessel

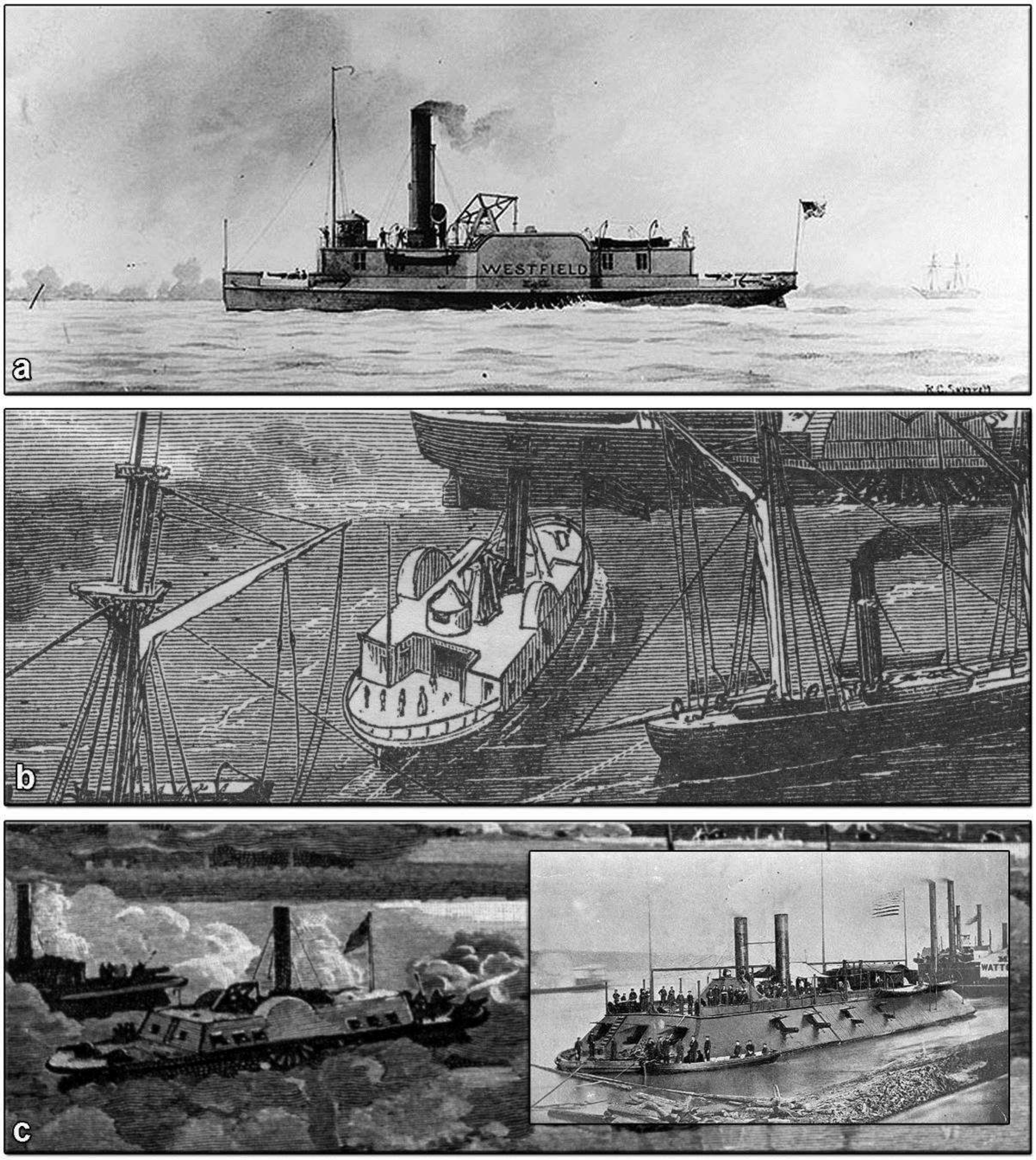


FIGURE 10. THREE VARIATIONS OF *WESTFIELD*. (A) R.G. SKERRETT'S *WESTFIELD* (DRAWN IN 1904) (NAVAL HISTORICAL CENTER, PHOTO 48488) (B) DETAIL OF PORTER'S MORTAR FLOTILLA ON THE MISSISSIPPI RIVER (*HARPER'S WEEKLY* 1862A), AND (C) DETAIL OF DAVIDSON ENGRAVING (*CENTURY ILLUSTRATED MONTHLY MAGAZINE* 1885*)* AND INSET OF USS *CAIRO* (NAVAL HISTORICAL CENTER NH 61568)

Westfield is depicted as a hybrid ferry gunboat/ironclad, which bears a resemblance to USS *Cairo* (Figure 10c). Another often-published image of *Westfield* extinguishing fire rafts in the Mississippi River appears to have been based on a sketch by Daniel Nestell of *Clifton* engaged in the same task (*Harper's Weekly* 1862b; Moftelay and Campbell 1890). Images from these publications were often based upon verbal eyewitness accounts or dramatized recreations of unobserved events that are somewhat unreliable. Though some of these images may have been based upon stylized contemporaneous sketches, they lack sufficient detail to use for comparison.

Military Service

The gunboat USS *Westfield*, upon its completion, was assigned to Commander Porter's Mortar Flotilla and later to the West Gulf Blockading Squadron, the cruising ground of which extended from Pensacola to the Rio Grande. The squadron was commanded by Admiral David G. Farragut until late 1864, with Commander Henry H. Bell in charge of the vessels in the Gulf (Soley 1898:123, 141). The three main focal points of the West Gulf Blockading Squadron were New Orleans, Mobile, and Galveston. New Orleans was the largest and wealthiest city in the south and ranked sixth in the United States for the size of its population (Soley 1898:126, 132, 140).

Westfield departed Staten Island to begin its military service on February 22, 1862 (Paulding 1862c). Commander William B. Renshaw, a 30-year veteran of the Navy, was given command of *Westfield* (*Haverhill Sunday Record* 1927) and was ordered to join Commander David D. Porter's Mortar Flotilla bound for the Mississippi River. *Westfield* was delayed on its trip southward by two storms, including a "terrible storm" on February 26 off of Cape Hatteras, North Carolina, which tore planks from *Westfield*, forced *John P. Jackson* back to Baltimore for repairs, and sank *R.B. Forbes*. *Westfield* put in at Port Royal, South Carolina, following the storm and remained there for repairs until March 8. From Port Royal, *Westfield* continued to Key West, arriving there on March 10. At Key West, *Westfield* was rejoined by *Clifton*, and they continued on to Apalachicola on March 13, arriving 2 days later (Cotham 2006:43–44).

Porter's Mortar Flotilla

After heavy winds and storms briefly delayed Renshaw, *Westfield* joined Porter's unit at the mouth of the Mississippi River on March 18, 1862 (Farragut 1862a; Porter 1862). Although *Westfield* was one of many ships in the Union force assaulting the Mississippi River ports, the significance of *Westfield*'s involvement can hardly be overstated. Without the aid of a handful of converted ferryboats, it is quite possible that neither Farragut's large sailing vessels nor Porter's Mortar Flotilla could have launched the attacks on New Orleans and Vicksburg as planned. Upon their arrival at the Passé á l 'Outre (Outer Pass of the Mississippi River), *Westfield* immediately set to work with 3 other vessels towing the 21 mortar schooners across the bar at the mouth of the river (Porter 1862). Westfield spent the next "two weeks in towing the sailing vessels of the fleet over the bar and tugging off those of the larger vessels which had run aground" (Cotham 2006:45). Once all the vessels in Porter's flotilla had successfully entered the river, Westfield and fellow converted ferryboat Clifton were primarily engaged in towing the mortar schooners, which were essentially floating batteries, into a position to shell the Confederate Forts Jackson and St. Philip (Cotham 1998:59).

During the first part of April 1862, *Westfield* provided the defense for a coast survey party preparing accurate maps of the Mississippi River. These maps were later used during the planning stages to determine the precise locations for placement of mortar ships for the assault on Forts Jackson and St. Philip (Renshaw 1862b). On Sunday, April 13, Gusley reported they had completed painting the vessels with Mississippi mud and covering the top masts of bomb schooners (mortar ships) with tree limbs (Gusley 1862, in Cotham 2006:47). By Friday, April 18, all of the fleet had been moved into position and the shelling of Fort St. Philip and Fort Jackson, just below New Orleans, commenced. On the following Thursday, Gusley reported that "we succeeded in getting our heavy vessels above the forts, with but comparatively small loss" (Gusley 1862, in Cotham 2006:49). "The fleet below the forts (to which *Westfield* was attached) kept up their firing until Sunday, the 27th, when a flag of truce was sent to us. . ." (Gusley 1862, in Cotham 2006:51). Marines from *Westfield* were ordered to land and take possession of Fort Jackson on Monday, April 28, when the two forts surrendered to Commander Porter.

Westfield proceeded on to New Orleans on April 29 to join Farragut's fleet, which had captured the city (Cotham 2006:52). *Westfield* was occupied for the next 6 weeks traveling in the vicinity of New Orleans (Cotham 2006:56–72). On June 19, she departed for Vicksburg, sailing up the Mississippi River and arriving on June 24. On June 26, the flotilla initiated their bombardment of Vicksburg, an activity in which it would be intermittently engaged until the conclusion of the siege on July 15 (Cotham 2006:73–82).

During its time on the Mississippi, *Westfield* protected the Union fleet from destructive fire rafts set afloat by the Confederate military (Massa 1862; Renshaw 1862a; Roe 1862). Fire rafts were a collection of dry brush set ablaze (one example was a flat boat with a pile of pitch pine cord) and directed towards an enemy fleet with the intention of spreading fire to the wooden vessels (Headley 1902).

Westfield's heroic actions extinguishing these fire rafts were illustrated and published in both *The Soldiers in Our Civil War* (Moftelay and Campbell 1890) and *Frank Leslie's Illustrated Famous Leaders and Battle Scenes of the Civil War* (Moat 1896). *Clifton* is also depicted repelling a fire raft in *Harper's Weekly* (1862b). The engravings of *Westfield* and *Clifton* are likely based on the sketch by Daniel Nestell, the surgeon stationed on *Clifton* (Figure 11).

The actions that led to the capture of New Orleans and the siege at Vicksburg had taken a toll on the ships of the Mortar Flotilla. Commander Renshaw sent a letter to Farragut at the end of August stating that several of his vessels were in need of serious repair and his crews were battling fever and scurvy (Renshaw 1862c). Rear-Admiral Farragut reassigned *Westfield* to the Gulf of Mexico in the fall of 1862, following a month of rest for the exhausted crew (Farragut 1862b). USS *Westfield* became the flagship for the West Gulf Blockading Squadron, Mortar Flotilla, and a participant in the blockade of the Texas Coast. Renshaw's flotilla consisted of *Westfield, Harriet Lane, Clifton, Owasco,* and *Henry James* (Renshaw 1862d).

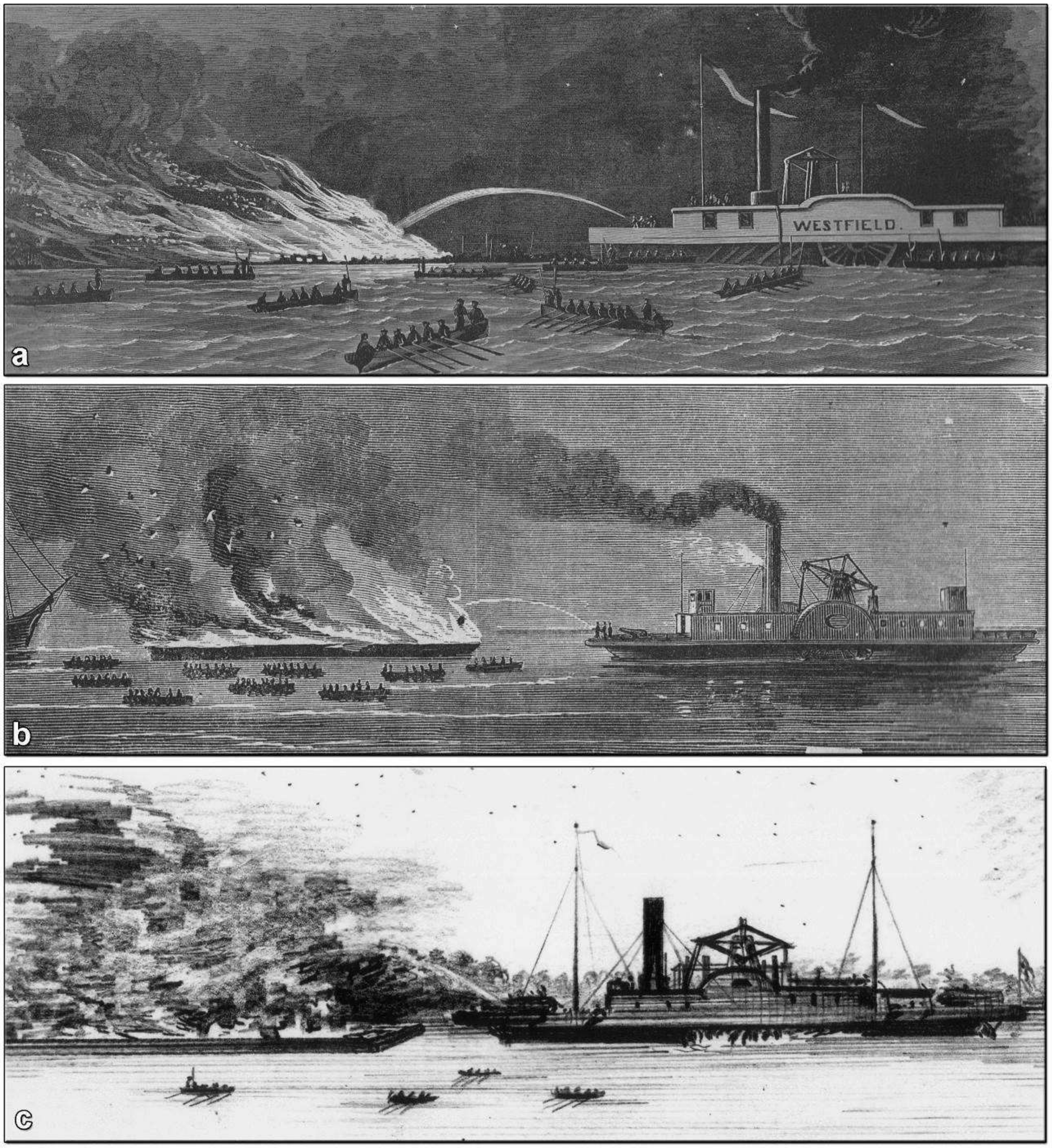


FIGURE 11. FERRY-GUNBOATS EXTINGUISHING FIRE RAFTS ON THE MISSISSIPPI RIVER
(A) *WESTFIELD* (MOFTELAY AND CAMPBELL 1890:304) (B) *CLIFTON* (*HARPER'S WEEKLY* 1862B), AND
(C) NESTELL SKETCH OF *CLIFTON* (COTHAM 2006:20)

West Gulf Blockading Squadron

Galveston became the focus of the blockade in Texas, as it was the largest community in the state and the most important maritime port on the Texas coast (Appendix A-3). Blockade-running quickly became a highly lucrative venture, as most vessels were able to slip easily past the porous Union blockade and into the rivers and bays of southern Texas or into Mexico. Galveston, on the other hand, was essentially sealed off by the blockade, crippling most maritime traffic flowing through the port.

Westfield departed for Galveston on October 1, 1862, and arrived the following day. A request for surrender was sent to the fort on the morning of October 4. That afternoon, the city was fired upon and captured. The following afternoon, marines (including Gusley) were sent ashore at Pelican Spit to occupy the barracks. Although the batteries in and around Galveston looked formidable, Union forces quickly learned that the Confederates had very few heavy guns. Following a brief disagreement about the terms of surrender, Colonel Cook of the Confederate Army capitulated and promised to raise the United States flag over the city on October 8, 1862. Commander Renshaw agreed to a 4-day period for the evacuation of all women, children, and other noncombatants. Colonel Cook used this time to reposition four guns from the Galveston area forts to the battery at Virginia Point, on the mainland. This act angered Renshaw as he viewed it as a breach of faith on the part of the Confederate Army (Renshaw 1862d). The marines were recalled to *Westfield* on the morning of October 9 in order to accompany the squadron to Galveston where the mayor delivered the keys to the customhouse to Captain Jonathon M. Wainwright of *Harriet Lane* (Cotham 2006:104–106). Following the capture of Galveston, Renshaw contacted Rear-Admiral Farragut and apprised him of events. He also requested additional troops for the occupation of the city. Farragut congratulated Renshaw on his success and expressed regret that additional troops were not available (Farragut 1862b; Renshaw 1862e).

Renshaw remained at Galveston nearly a month, during which time he was asked by J. Berkemeier, consul of Austria, Saxony, Holland, Bremen, & Lubeck, to return the escaped local slaves he was harboring. Renshaw declined to return the slaves, as the institution of slavery was not recognized by “any of the governments you represent” (Renshaw 1862f). Following this incident, in late October, Renshaw departed for Matagorda Bay with *Westfield* and *Clifton. Westfield* arrived offshore of Matagorda Bay on the morning of October 23. Gusley states that they started up the bay that afternoon but “had not proceeded far before [we] missed the channel and ran hard aground” (Gusley 1862, in Cotham 2006:111). *Clifton* grounded while attempting to aid *Westfield.* During the flood tide, *Clifton* dislodged and was afloat, though it took nearly 24 hours for the two vessels to free *Westfield*. This was accomplished only after *Westfield* was lightened by pumping water from her tanks.

The crew of *Westfield* rode out a strong norther on Saturday, October 25, while anchored in Lower Matagorda Bay within sight of Indianola. *Westfield* captured the schooner *Le Compte*, which was set afire by its crew and then abandoned. The fire did not consume the vessel, which was successfully captured and added to the Union fleet. Gusley states that they exploded “a few 9-inch shell over the escaping crew” (Gusley 1862, in Cotham 2006:113). A Confederate sailor later recounted a conversation with Commander Renshaw and Captain Law, of *Clifton*, upon their arrival at Indianola.

The sailor, H.B. Cleveland, stated that Renshaw told him that ". . . three rifted [*sic*] guns and six IX-inch guns. . ." were in his possession and with those guns ". . . he could command the bay . . ." (Cleveland 1862). The embellished account of *Westfield*'s armament was likely purposely employed to intimidate local leadership.

On October 26, some of the Indianola city fathers gathered on *Westfield* to meet with Commander Renshaw. Gusley was not privy to Renshaw's conversation with the city fathers, but he says they "left the boat in a very good humor . . . and our weighing anchor soon after, leaves the inference that all was right in that quarter. We heard here of sundry schooners having set sail when we first came in sight [of Indianola], and our hurry in leaving was also partly owing to the hope of capturing some or all of them as prizes. We had not gone far, however, when we discovered them (some 15 or 20) spread out across the channel, their keels upon the bottom and their hulls beneath the water" (Gusley 1862, in Cotham 2006:114)

In his diary, Gusley does not mention the Union shelling of Indianola, which resulted in the deaths of one Union and two Confederate soldiers (Malsch 1977:168). Nor does Gusley discuss the immediate surrender of Indianola, an event recounted by Robert Rhodes, an officer on board *Clifton* (Gusley 1862, in Cotham 2006:194, footnote 13). Later the same evening (October 26), *Westfield* anchored 4 miles from the town of Matagorda where they spent the following Monday and Tuesday (Cotham 2006:114).

On Wednesday, October 29, *Westfield* steamed back toward the mouth of Matagorda Bay to meet a mail steamer and then headed for Lavaca, in the northern portion of Matagorda Bay. They anchored off Lavaca on Friday, the 31st, and commenced bombardment of the town after surrender had been refused. In the evening, at about sundown, the 100-pounder Parrott burst and wounded three men. The following day, they recommenced bombardment but halted after 2½ hours firing since they were running low on ammunition (Cotham 2006:115).

On November 4, after a stay of 13 days, *Westfield* departed for Galveston arriving the following day. While safely at anchor during a norther on November 7, the crew heard that a rebel ram had "made its appearance" at Pelican Spit in Galveston Bay. The rumors of an impending rebel attack would continue unabatedly from that day (Cotham 2006:116–118, 124). In late November, Renshaw dispatched the gunboat *Kittatinney* and mortar boat *Henry James* to Pass Cavallo where they succeeded in capturing the schooners *Matilda* and *Diana* (Lamson 1862). *Clifton* also disembarked for Sabine Pass in early December to check on reports of rebel movements in the area (Law 1862)

Westfield anchored in the Bolivar channel on November 28. The following day, the steamer gave chase to a suspected rebel ram coming down the bay. The Confederate ram, upon witnessing *Westfield* preparing to raise anchor, turned and fled back up the bay. *Westfield* gave chase, only to fall back when confronted with the risk of running aground. *Westfield* fired a 9-inch shell at the retreating vessel (Cotham 2006:122). December was a largely uneventful month, highlighted by the disruption of Confederate activities near Virginia Point where they were building a battery and chasing a herd of cattle to obtain beef (Cotham 2006:124–126). On Christmas day, Companies D, G, and I of the Forty-second Massachusetts Volunteers, under the command of Isaac Burrell, were landed at Galveston and quartered into a large two-story warehouse at the end of Kuhn's Wharf. These troops were originally to have been landed at Pelican Spit, but the wharf was selected as it was in the city and under the protection of the ship's guns (Long 1863). Five days later, Confederate soldiers set fire to the Bolivar Point lighthouse, demolishing the structure's use as a navigational aid for the Union fleet (Cotham 2006:127–128).

The Battle of Galveston

In the dark early morning hours of January 1, 1863, Confederate General J. Bankhead Magruder commenced a combined land and sea attack on Union troops at Galveston. Portions of the wharf had been destroyed so that Confederate soldiers could not directly advance on their position (Duganne 1865:231; Magruder 1863b:3). Contemporaneous eyewitness accounts disagree on various aspects of the battle, especially in regard to the timing of events and Renshaw's actions. These are summarized in Table 4.

Between 1:30 and 2:00 A.M., two to four rebel steamers were seen proceeding down the bay toward Galveston (Agaius 1863a:2; Bosson 1886:88; Duganne 1865:235–236; Law 1863; Palmer et al. 1863). *Westfield* was on patrol at the harbor mouth, looking for blockade runners, but quickly got underway upon learning of the enemy's approach (Tucker 1918:364). Both *Clifton* and *Harriet Lane* have been accredited with originally observing the movement of the Confederate steamers, though *Harriet Lane*'s position may have provided a much better vantage point.

While en route to investigate the steamers, *Westfield* ran hard aground near Pelican Spit. Major Burt (1863), an eyewitness to *Westfield's* loss, reported the tide was ebbing at the time the ship grounded. The ebb tide is confirmed by NOAA (2010) tide predictions for December 31, 2006 when astronomical conditions were virtually identical to January 1, 1863. There was a waxing gibbous moon with 90 percent of the visible disk illuminated on January 1, 1863 (Naval Oceanography Portal 2010). The moon set on that morning at 4:20 A.M. and the sun rose at 7:14 A.M. Astronomical conditions (affecting tides) on December 31, 2006 were almost identical: a waxing gibbous moon, 90 percent illuminated; moonset at 4:24 A.M. and sunrise at 7:13 A.M. Tides and currents predicted for December 31, 2006 (NOAA 2010) should be representative (not accounting for variations due to weather) of the morning when *Westfield* ran aground. Incidentally, New Year's Day 1863 would have been one of the 10 lowest tides of the entire year (forecast for December 31, 2006, as –0.9 ft MLLW; NOAA 2010). Discounting wind conditions, which were not reported as a factor, the tide should have been falling since before midnight, reaching maximum velocity of about 2.4 knots at 6:01 A.M., shortly before sunrise, and slacking at 10:38, nearly 40 minutes after *Westfield* was destroyed. The next high tide would not occur until about 4 P.M.

Table 4. Selected Accounts of the Battle of Galveston

Date	Author of Account	Type of Source	Account Summary or Quote	Reference
1863	Major William L. Burt	Eyewitness Union account from major in the U.S. Army on board *Mary Boardman*	At 3:00 A.M., 4 Confederate gunboats were seen coming down the bay. *Westfield* ran aground after trying to "run up to the assistance of the town"; tide was running out when grounded. " At about 10 A.M., while the Commander's boat and crew and second cutter and crew were at the *Westfield* to receive the last men the commander having poured turpentine over the forward magazine and just over where she was aground, set her on fire with his own hand. He stepped down into his boat, in which were First Lieutenant Zimmerman, Chief Engineer Greene, and two oarsmen. The magazine immediately exploded, tearing the bow of the vessel open and blowing her to pieces to the water's edge and back to the smoke stack. After the explosion, no living thing could be seen. She did not sink, being aground; and her guns aft, which were double-shotted and run out, as the flames should reach them, threatened us, at the short distance we were from her, with destruction, which might have been foreseen when she was fired."	Burt 1863
1863	Unknown correspondent	Eyewitness account from *Mary Boardman*	"Capt. LEWIS, of the *Clifton*, immediately came off to the flagship in a small boat, and after a brief interview with Commodore RENSHAW, returned to the *Clifton*. The Commodore immediately sent a boat to the *Mary E. Boardman*, asking of Capt. WIER permission to transfer the men, ship's furniture, personal effects, &c., of the *Westfield* to the *Boardman*. This was of course granted, and the effects hurriedly transferred…It was now 10 o'clock in the morning; the crew (and their baggage) of the *Westfield* had been entirely transferred to the *Boardman* and the *Saxon*, a United States transport lying in the harbor nearby. The Commodore's gig, with its crew, was lying alongside of the *Westfield*, while the Commodore, his First Lieutenant, and Chief Engineer, had remained on board to make sure of her destruction. Barrels of turpentine had been poured over the decks, the safety valve of her boiler had been chained down, the magazines had been opened, the trains laid, and everything in readiness for the application of the match. The officer of the vessel, save the Commodore, had taken their seats in the gig; the Commodore's tall form was alone seen upon the deck of the ill-fated *Westfield*. The match was applied, when from some unexplained cause, horrible to relate, the forward magazine exploded with a terrific report, instantly destroying the entire forward part of the vessel, and sending high into the air a cloud of dense black smoke, sheets of iron, planks, shells and missiles of every conceivable form and kind." "The Captain's gig was discovered floating, but not a soul to be seen in her. The crew of the first cutter, which had been quietly resting upon their oars nearby, had also entirely disappeared." Approximately 23 casualties.	*New York Times* 1863
1863	"Agaius," news correspondent	Compiled Union eyewitness accounts	Three Confederate steamers were observed coming down the bay at 1:30 A.M. and were pursued by *Westfield* and *Clifton*. *Westfield* was carried by a strong current from 20-ft water to 5-ft water and ran hard aground. At the time of her grounding, the tide was at full flood. "As soon as it was decided to blow up the *Westfield*, Commander Renshaw gave the order to clear the ship, and a scene of confusion followed. The men hastily collected their clothing and other articles, and thrusting them bags, tossed bags, hammocks, small arms, furniture, and various other personal effects into the boats, which went back and forth between the *Westfield* and *Boardman*. The *Saxon* took off some forty odd officers and	Agaius 1863a

Table 4 (Cont'd)

Date	Author of Account	Type of Source	Account Summary or Quote	Reference
			men, and the remainder of the crew that succeeded in getting clear of the *Westfield* went on board the *Boardman. . . .* The decks were covered with turpentine, trains were laid to the magazine, which were opened, and the safety-valves of the boilers were chained down to make the total destruction of the vessel more certain. The magazines were full of powder, there were one hundred loaded shells on deck, and the guns were loaded for action. A fire was lighted on the gun-deck forward, and the ship abandoned. The Captain's gig was alongside, containing Liet. Zimmerman, Chief Engineer Green, Kellihan, the quarter gunner, and the gig's crew were alongside waiting for Commander Renshaw, who had been once in the gig, but had just set foot on the ladder as if to go back, when the vessel blew up with a tremendous explosion. Fragments of shot and shell, splinters of timber, were hurled to immense height, and what remained of the shattered hull, settled as if forced down by enormous weight. . . . It is plain that the explosion of the after magazine was premature and not apprehended by any of those who were lost." The after magazine exploded.	
1863	Assistant Engineer W.S. Long	Union army account	Two boats were seen west of Pelican Island while three boats were attacking *Harriet Lane* (between 4 and 5 A.M.). *Westfield* was in Bolivar Channel and ran aground in pursuit of these boats. At 8:45 A.M., the after magazine prematurely exploded, killing Captain Renshaw, Lieutenant Zimmerman, 2 officers, and the crew of the captain's gig.	Long 1863
1863	Lieutenant Commander R.L. Law	Primary account from a Union officer	Approximately 15 casualties including Renshaw, Zimmerman, and Green.	Law 1863
1863	Charles A. Davis, Lieutenant	Eyewitness account of a Union officer , U.S. Army, Adjutant Forty-second Regiment, on Kuhn's Wharf	Soon after 3:00 A.M., the 42nd Regiment signaled the fleet about the advancing Confederate land artillery. After the capture of *Harriet Lane*, a flag of truce was raised at 8:00 A.M. While the flags of truce were up, Davis witnessed the Confederates hauling off men as prisoners. *Westfield* blew up with Commander Renshaw, 4 of his chief officers, and 6 men. Truce beginning at 8 A.M.; 11 men killed.	Davis 1863:457–459
1863	J.M. Foltz	U.S. Navy Fleet Surgeon	13 men missing and assumed killed in the explosion: Commander William B. Renshaw, Lieutenant Charles W. Zimmerman, Acting Assistant Engineer W.R. Green, John Calahan (gunner's mate), Samuel P. King (quarter gunner), W. Esser (coxswain), Rodolphus C. Hubbard (ordinary seaman), Henry Bethke (seaman), Peter Johnsan (seaman), Matthew McDonald (ordinary seaman), Hugh McCabe (second class fireman), William Reeves (second class fireman), George E. Cox (second class fireman). 13 men killed.	Foltz 1863
1863	James S. Palmer, Melancton Smith, and L.A. Kimberly	Account based on testimony before the court of inquiry	At 1:30 A.M., 2–3 Confederate steamers were discovered entering the bay. At 7:30 A.M., a flag of truce was raised on *Harriet Lane*. While the flags of truce were flying, the Confederate troops were taking Union troops as prisoners. Renshaw refused the terms of the agreement, ordered his fleet out of the bay and the destruction of the *Westfield;* 13 to 18 casualties were reported including Renshaw, Zimmerman, and Green.	Palmer et al. 1863
1863	"Agaius", news correspondent	William H. Hunt, Sergeant of Company 1, 42nd Massachusetts Regiment	According to Hunt, the Confederates began the engagement at 4:30 A.M. by firing their gun and that the engagement lasted three hours. Three "rebel cotton boats, one a hospital ship, and the others called Bayou City and Neptune" moved upon *Harriet Lane*. The Union surrendered at 8:00. He does not mention the destruction of *Westfield*.	Agaius 1863b
1863	Lieutenant-	Eyewitness account	*Harriet Lane* signaled "Enemy on shore" at 2:30 A.M. After this, *Westfield* made a signal that Wilson did	Wilson

Table 4 (Cont'd)

Date	Author of Account	Type of Source	Account Summary or Quote	Reference
	Commander Henry Wilson	from USS *Owasco*	not understand. At 5:30, 3 Confederate steamers were headed towards *Harriet Lane*. *Owasco* went to her aid and disabled one of the steamers. 13 men killed.	1863:439–440
1863	Major-General Bankhead Magruder	Commanding Officer of the Confederate Navy	Renshaw destroyed *Westfield* during the last hour of the 3-hour truce as Magruder was sending another flag to Renshaw claiming all of the vessels in Renshaw's fleet as prizes. Magruder takes credit for running *Westfield* aground. Commodore Smith sent a flag to Renshaw and gave him 3 hours.	Magruder 1863c:215–216
1863	Rear Admiral D.G. Farragut	Account from commander of the West Gulf Blockading Squadron.	". . . was a premature explosion, in consequence of which the captain, Commander W.B. Renshaw, and the first lieutenant, Lieutenant Chas. W. Zimmerman, the [illegible] W. R. Greene, and eight or ten men, lost their lives." Reported 11 or 13 casualties including Renshaw, Zimmerman, and Greene.	Farragut 1863
1863	"Agaius," news correspondent	Compiled Union eyewitness accounts	Four Confederate gunboats came out of Buffalo Bayou to attack the Union fleet at 2 A.M. Captain Renshaw, Lieutenant Zimmerman, Engineer Green, 2 quartermasters, and a boat crew of 5 were killed in the explosion–total of 14 men killed.	Agaius 1863b
1865	A.J.H. Duganne	Compilation of Union accounts	*Clifton* sighted two Confederate steamers approaching the channel from the north at 2 A.M. and signals the fleet. *Westfield* was already aground and signaled to *Clifton* to tow her off the bar, which by 3 A.M. results in a failed attempt. "So the battle of Galveston was tricked away—'won half by blunder, half by treachery;' while that fool or knave, flag-officer Renshaw, fired not a single long-range gun, allowed not one of his eager men to volunteer on board another ship, and ended by capitulation as disgraceful as it was entirely needless. The Clifton and Owasco, at a word from Renshaw's lips, might have cut out the Harriet Lane, with Smith and all his horse-marines. Instead of being permitted to do this, our gunboats, with their gallant crews, who muttered curses neither few nor choice, were ordered from the port, and, as a noble tar expressed it, in my hearing, 'sneaked away with white rags flying.' But the retributive hand of justice reached the wretched Renshaw ere his shame was fully consummated. He had given his men free access to the liquor-room, and then set fire to *Westfield*, intending to escape in a boat which lay alongside, with Lieutenant Zimmerman and several sailors, ready to cast off. Whether the boat delayed 'till it could hail the Clifton as she passed, or whether it was kept to take the recreant commodore ashore, can never be known. But as our other vessels, in retreating, steamed just abreast their flag-ship, she blew up, and Renshaw perished with her. He was not permitted to survive the sequel of his cowardice or treason."	Duganne 1865:235–242
1866	Horace Greeley	Compilation of Union Accounts	"Law repelled the suggestion, yet accompanied the Rebel Officer to Renshaw on *Westfield*, who rejected the proposal; ordering our vessels afloat to get out of harm's way so soon as might be, while he, despairing of getting the *Westfield* off. Would blow her up, and escape with his crew on the transports Saxon and Boardman, lying near him. He did blow her up, accordingly; but the explosion must have been premature, since Renshaw himself, with Lt. Zimmerman, Engineer Green, and ten or fifteen of his crew, perished with her. An eyewitness states all had left her but Renshaw himself when she was fired (it was said by a drunkard) and blew up, killing eight to ten officers and men I/2 the captain's gig beside her."	Greeley 1866:324–325
1876	"Sioux" (William P. Doran)	Compiled Confederate eyewitness accounts from correspondent in	"While the officers with the flag of truce sent ashore (?) were parleying with Col. Scurry and Major Leon Smith, the men abandoned the stranded ship in their boats and placed a slow match so as to blow her up. After getting some distance away, the vessel having failed to fire, Commodore Renshaw,	Sioux 1876

Table 4 (Cont'd)

Date	Author of Account	Type of Source	Account Summary or Quote	Reference
		Galveston at the time	Midshipman Zimmerman and several sailors returned to her to try it again, when, just as they had all got on her deck, the magazine of the ship exploded, tearing her to pieces and the brave sailors to atoms. "	
1882	E. Jarvis Baker	Primary account from a soldier of the 42nd Massachusetts regiment on Kuhn's wharf	". . . so sending his sailors off Commander Renshaw lit the train that was to destroy his ship and took to his boat, but for some reason (never to be explained) he returned, and had just reached the deck when the magazine exploded and the *Westfield*, splitting fore and aft, opened like a book, crushing the gig with its crew awaiting at her side, and leaving the guns (all shotted), in a most convenient position, and in good condition, to be removed, a few days later by the confederates, and mounted onshore as part of the city defense." Baker refers to Renshaw as a traitor and the sole cause for the loss of the battle.	Baker 1882:24
1883	James Russell Soley	Compiled accounts	*Westfield* became grounded during high water.	Soley 1898:149
1886	J. Thomas Scharf	Compiled Confederate accounts, including his own first-hand accounts (unknown if all are first-hand)	"The decks were saturated with turpentine, and the last of the crew, with Commodore Renshaw, were just about to leave the ship. The gig was ready and the commodore was the last to descend. The torch was applied – a bright flash ran along the deck – the commodore turned his face to look at the vessel of the last time. The sailors rested a moment on their oars; all eyes were turned in the direction of the *Westfield,* attracted by the vivid flame. It was a moment of surprise and of perfect silence, and it was only a moment; then there was a flash of blue smoke and a fearful explosion. The shells of the magazine, rising in the air, burst far up. There was a plunging noise in the water, such as is occasioned by the falling of a heavy body, and then for a radius of four or five hundred feet there was a shower of fragments which sounded like falling rain. The *Westfield* was seen to part or burst out forward, like a chestnut burr, and when the smoke was cleared away there was no sign of life about her. Forward she was blown into fragments down to the water; but the machinery had not been destroyed, as the singing of the steam was distinctly heard after the explosion. The commodore's boat and all in it were annihilated in the terrible catastrophe – scattered through the air in fragments. The smoke-stacks and the after part of the ship lay in a black mass in the water for ten minutes, when there was another flash, and she was speedily wrapped in flames."	Scharf 1887:507–508
1886	Sergeant-Major Charles P. Bosson		*Harriet Lane* noticed confederate steamers approaching and signaled the fleet. Seemingly at the same time, *Westfield* made the same observation and got under way to pursue when she ran hard aground in high water. *Clifton* left her post to assist getting *Westfield* off the bar between midnight and 1 a.m. "Renshaw refused to accede to the Confederate proposition, and ordered Law to get every vessel out of port with dispatch while he blew up the *Westfield,* as all attempts to float her had failed" (Bosson 1886:107). "Renshaw sent *Westfield's* crew on board transports *Saxon* and *Mary Boardman,* and a slow-match was applied to a train of powder leading to her magazine. As no explosion took place at the expected time, he went back in a row-boat with Lieutenant Zimmerman, Engineer Green, two quartermasters, four firemen, and five sailors. As Renshaw was about coming over her side into the row-boat again, a premature explosion took place. The *Westfield* fell to pieces, and not a vestige of the boat's occupants was ever seen again. This was about ten o'clock A.M." (Bosson 1886:112).	Bosson 1886:88
1889	Henry G. Gusley	Eyewitness account from a Union marine stationed on *Westfield*	"At ten (10) o'clock, The Gun Boat, *Westfield* was blown up by a fuse set by her officers, after the Crew had abandoned her. The explosion not coming as timed, Commander Renshaw ordered his Boat back alongside to light another, when the delayed explosion occurred; killing him, Lieutenant Zimmerman, Gunners Mate Callehan, Quarter Gunner King, Coxswain Kasser (??), Seamen Belke, Hubbard, Johnson &	Gusley 1889

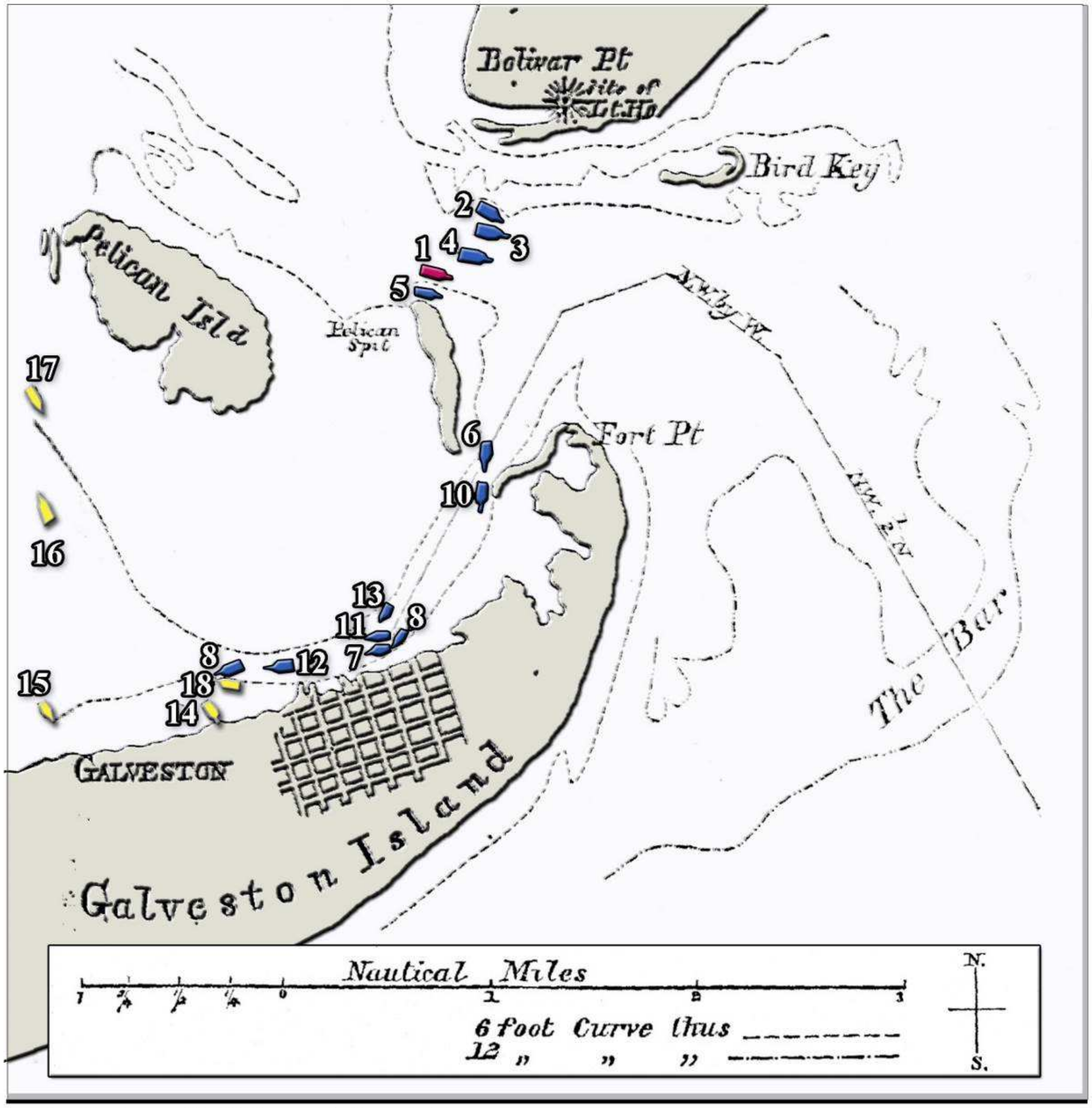
Table 4 (Cont'd)

Date	Author of Account	Type of Source	Account Summary or Quote	Reference
			McDonald, Firemen Cox, Reeves & McCabe. The balance of the crew were on board The Transports, M.A. Boardman and Saxon, screw Propeller Steamship, on their way to New Orleans."	
1892	John Quick	Eyewitness Confederate account, retold 29 years later	"The flag ship *Westfield*, under Commodore Renshaw, was hard and fast aground on the flats abreast of Pelican. It was determined to blow up the vessel, and the crew were removed to the transports *Saxon* and *M.A. Boardma*n, and a slow match applied to the magazine. It did not go off as soon as expected, and a boat's crew was sent to see what was the matter. No sooner had the boat hauled alongside the *Westfield* than a tremendous explosion occurred, which was heard for ninety miles, and boat and crew were scattered into a thousand fragments. Those in the boat that lost their lives were Commodore Renshaw, Lieut. Zimmerman, Gunner's Mate Callahan, Quarter Gunner Ring, Coxswain Esser, Seaman Bethke, Hibbard, Johnson, and McDonald, and fireman Cox, Reave, and McCabe"	*New York Times* 1892:17
1908	John Quick	Eyewitness Confederate account, 45 years later	"The federal gunboats hoisted the white flag and then ran away. Commodore Renshaw, seeing all was lost, his flagship aground, put a slow match to the magazine to blow her up. It was slow, so he took a boat's crew to see what was the matter. As soon as he got there she blew up with tremendous force. This was the last of the commodore and his flagship *Westfield*."	Quick 1908
1911	Robert Morris Franklin	Eyewitness account of a Confederate officer on board *Bayou City*, 48 years later	Two cottonclads (*Bayou City* and *Neptune*) and two river steamers (*John F. Carr* and *Lucy Gwin*), serving as tenders, moved down the bay. Around midnight as they lay near the west end of Pelican Island, the Union fleet signaled their presence. Around this time, *Westfield* ran aground. After *Lane* was attacked, Law requested a 3-hour truce. *Westfield* blew up as the period of truce was coming to a close."The crew was removed, with the exception of Commander Renshaw, Lieutenant Zimmerman, two other officers and the crew of the captain's gig, thirteen in all, who remained to fire the vessel. The fire was applied by Captain Renshaw. He was descending the ladder, and all the rest were in the boat about 9 o'clock when the magazine prematurely exploded" (Franklin 1975:9).	Franklin 1911
1918	Philip C. Tucker, III	Compilation of Confederate accounts, based upon papers of an officer present at the battle and the Confederate Prize Proceedings	*Westfield* was patrolling the harbor entrance for blockade runners, when, at 2 A.M. an alarm was sounded that the enemy was approaching. *Westfield* headed up Bolivar Channel in pursuit and ran hard aground off the east end of Pelican Island. When the Confederate ships retreated, no imminent threat was perceived and *Westfield*'s crew was ordered back to their hammocks (Tucker 1917:364). A train was laid to *Westfield*'s magazine, but when it did not detonate, Renshaw returned with his crew of 20 men at 8:45 A.M., only to be met by the delayed explosion, killing all 21 men (Tucker 1917:368).	Tucker 1918:364, 368

Westfield "struck bows [*sic*, stern] where the water was only seven feet deep, though at the stern [*sic*, bow] there were nearly four fathoms [24 ft]" (Unidentified 1863). The suspicious steamers altered their routes and retreated 6 miles away to Half Moon Shoal (Bosson 1886:88–89). Union commanders, mistakenly believing the steamers were merely on reconnaissance, ordered troops and crews to return to their berths and barracks (Bosson 1886: 89; Tucker 1918:364).

Magruder, "under cover of darkness," reinforced Galveston with shore batteries placed along a 2½-mile-long line within the city (Magruder 1863b:3–4). Sometime between 2:30 and 3:30 A.M., the 42nd Regiment observed Confederate artillery advancing on their position and notified the fleet. *Harriet Lane* signaled "enemy on shore" (Davis 1863:457–459; *New York Times* 1863; Wilson 1863). *Westfield,* which was still aground, sent a signal requesting help, after which *Clifton* headed away from Galveston, passed *Owasco* (anchored between the city of Galveston and Pelican Spit), and proceeded to the gunboat (*New York Times* 1863; Wilson 1863). *Clifton* tried without success to pull *Westfield* free. Just after 4:00 A.M., Magruder fired a gun to signal the naval attack (Bosson 1886:90; Wilson 1863). The discharge of the cannon immediately set into motion musketry and artillery fire from both sides. Confederate troops fired upon Union troops barricaded at the end of Kuhn's Wharf and the vessels *Harriet Lane*, *Corypheus*, *Sachem*, and *Owasco* (Figure 12). During this engagement, Confederate troops advanced by wading into the bay with ladders that were to be used to reach the end of the Kuhn's Wharf. The ladders, however, were not long enough to scale the wharf, and the Confederate land batteries continued to solely engage the Union troops from outside the wharf barricades (Magruder 1863c).

Captain Law, of *Clifton*, requested to leave *Westfield* and aid the fleet at Kuhn's Wharf. Renshaw granted this request but kept *Clifton*'s pilot, an act that may have prevented *Clifton* from hastily assisting the Union shore batteries (Duganne 1865:265). At 5:30 A.M., the Union fleet in Galveston Channel engaged Confederate steamers in battle (Wilson 1863). The Confederate fleet consisted of two steamboats reinforced with cotton (cottonclads), *Neptune* and *Bayou City*, and the steamers *John C. Carr* (hospital boat) and *Lucy Gwinn*, which had traveled down the bay from Buffalo Bayou during the night. *Royal Yacht*, one of two tenders (the other being *Lucy Gwinn*) used to collect firewood for the steamers, was originally a part of the attacking fleet but had run aground at Redfish Bar during the earlier advance on Galveston (Bosson 1886:88, 98; Wilson 1863). While attempting to reposition to better engage the incoming Confederate steamers, *Harriet Lane* also ran aground (Bosson 1886:101). *Bayou City* rammed *Harriet Lane*, but only struck a glancing blow (Bosson 1886:101). *Neptune* struck the steamer on the starboard side and opened fire upon the crew, during which Captain J.M. Wainwright was killed. *Neptune* turned and attempted to ram *Harriet Lane* on the port side but was fired into by *Harriet Lane*. *Neptune* took on water and was run aground at the edge of the channel where she sank in 8 ft of water (Bosson 1886:102). *Bayou City* struck *Harriet Lane* again, causing both vessels to become interlocked. The force of the impact careened *Harriet Lane* at such an angle that her guns could not be used. Crew from the two Confederate vessels killed the gunners of *Harriet Lane* and proceeded to board the vessel.



1. The steamer Westfield aground where she blew up.
2. The transport steamer Saxon.
3. Steamer with commissary stores for army.
4. U.S. schooner Velocity.
5. Coal bark Elias Pike. } Taken possession of by rebebl steamers after we left.
6. Coal bark Cavallo.
7. U.S. steamer Sachem. } While engaging the rebel batteries on shore.
8. U.S. schooner Corypheus.
9. U.S. steamer Harriet Lane during engagement
10. U.S. steamer Owasco, anchored on seeing signal "enemy on shore."
11. U.S. steamer Owasco, while engaging shore batteries and firing into steamers and after capture of Lane.
12. U.S. steamer Owasco engaging shore batteris and the steamer (ran aground).
13. U.S. steamer Clifton came and anchored after capture of Harriet Lane.
14.
15.
16. } Enemy's steamers when first seen and while engaging Lane and on running aground, etc.
17.
18.

FIGURE 12. UNION AND CONFEDERATE VESSELS AT THE BATTLE OF GALVESTON (*WESTFIELD* IS HIGHLIGHTED RED; THOUGH THEY ARE NOT LABELED IN THIS DRAWING, 14 IS *NEPTUNE* AND 18 IS *BAYOU CITY*. U.S. NAVY DEPARTMENT 1863)

Approximately 110 members of *Harriet Lane*'s crew were reportedly taken prisoner, and her commander, Wainwright, and first lieutenant were among those killed in the action (Bosson 1886:102-103; Burt 1863; Palmer et al. 1863). The *New York Times* (1863) reported that "out of her crew of 130 men, only one officer and 10 men were left alive. . ." though this account was greatly exaggerated; actual losses on *Harriet Lane* amount to only five killed (Penrose 1863; Tucker 1918:369–370,). Once on board the steamship, Confederate troops fired upon *Owasco* killing many of the gunners. *Owasco* then retreated from musket range.

The scene of the battle as it appeared at 6:30 a.m. was sketched by James Bourke (reproduced as Figure 13). Bourke's drawing shows *Harriet Lane* rammed by a cotton clad and under attack. *Owasco* is seen defending *Harriet Lane* before retreating. The 42nd Massachusetts Volunteers, barricaded at the end of Kuhn's Wharf (called Henleys Wharf by the Bourke), are under attack from Confederate artillery placements in the second story of the Henley Building. *Clifton* is shelling Fort Point. *Saxon, Mary Boardman* and a coal bark are standing by near Pelican Spit. And *Westfield* is seen aground on a sand bar, although its orientation is incorrectly portrayed with the bow directed westward.

Shortly after capturing *Harriet Lane*, a flag of truce was raised. A boat first took the flag to *Clifton* at about 8:00 A.M. and then proceeded to *Westfield* accompanied by Captain Law. Captain Law had agreed upon a 3-hour (or 2-hour, depending upon the source) truce to confer with Renshaw on *Westfield* (Bosson 1886:106; Tucker 1918:368). Commander Renshaw ordered the army transports *Saxon* and *Mary Boardman* to come alongside *Westfield* and assist in removing her crew and supplies. During the truce, Renshaw decided to destroy *Westfield* in order to prevent her imminent capture. Major Burt of *Mary Boardman* urged Renshaw to reconsider, and suggested instead to use the remaining vessels to protect *Westfield* while waiting for high tide (Burt stated in his report that the tide was running out when Renshaw decided to blow up *Westfield*). Major Burt was certain that *Westfield* would float and be saved as soon as the tide turned. He stated in his report, ". . . she was heavily armed and of light draft, she was invaluable. . ." (Burt 1863). Burt's suggestion was ignored, and his vessel was loaded with *Westfield*'s crew and their baggage. The remainder of the ship's supplies was placed aboard *Saxon* (Burt 1863).

At about 10 A.M. the ferry-gunboat exploded. Eyewitness reports vary greatly in regard to this moment, and some reports in particular are heavily embellished to convey the sometimes bitter sentiment regarding this loss (Renshaw has been described as a "fool or knave," "recreant," and "traitor" [Baker 1882:24, Duganne 1865:241]). The actions of Renshaw himself, during the battle and at the time of *Westfield*'s destruction, were heavily criticized by both Union and Confederate participants. Though accounts of the events may disagree, what is conspicuously absent is any marked sentimentality towards the death of Renshaw or any posthumous discussion of bravery or heroism in his attempt to prevent *Westfield*'s capture. His decisions in the days leading up to and including the battle were generally felt by his contemporaries to have culminated in the Union

FIGURE 13. BATTLE OF GALVESTON EYEWITNESS SKETCH (IMAGE PROVIDED COURTESY OF THE ROSENBERG LIBRARY, GALVESTON).

DRAWING LEGEND: "No. 1 - Reble [sic.] Gun Boat [*Neptune*?] with troops on fire; No. 2 - U.S.S. *Harriett Lane*; No. 3 – Reble Ram with troops [*Bayou City*?]; No. 4 – Reble Gun Boat with troops; No. 5 – U.S.S. *Owasco*; No. 6 – Henleys Building with Reble Artillery in the second story; No. 7 – U.S.S. *Sachem*; No. 8 – Henleys [Kuhn's] warf where the 42nd Mass. volunteers quartered; No. 9 – U.S. Schooner yatch [sic.]; No. 10 – coal Bark; No. 11 – U.S.S. *Clifton* shelling Fort Point; No. 12 – transport *Saxon*; No. 13 – coal Bark; No. 14 – transport *Mary Boardman*; No. 15 – U.S.S. *Westfield* Com. Renshaw a ground; No. 16 – Pellican [sic.] Spit; No. 17 – Hitchcocks shole [sic.] where the artist took the scetch from; Drawn By James E. Bourke, Galveston, Jan'ry the 1st, 1863. The Engagement as it appeared at half past 6 A.M."

defeat. Notable complaints levied against Renshaw included his decision to land the 42nd Regiment on the wharf instead of at Pelican Spit; assigning the difficult-to-maneuver *Harriet Lane* to Kuhn's Wharf instead of a double-ended ferry; hailing *Clifton* to *Westfield*'s aid after Confederate troops were observed advancing on the wharf; and destroying *Westfield*.

As the truce was coming to a close, Renshaw set a slow match to a powder train that led to the forward magazine of *Westfield*. The deck was saturated by barrels of turpentine, the boiler safety valves were chained down, and at least one magazine (located in the lower holds of the bow and stern) was opened (Bosson 1886:112, Agaius 1863b, *New York Times* 1863). The ensuing events are unclear as there are disagreements in the eyewitness accounts. Renshaw returned to the captain's gig, though it has also been reported that two small boats were alongside the gunboat, instead of a single boat (Burt 1863; *New York Times* 1863). Most accounts describe Renshaw as attempting to reboard *Westfield* at the moment of the explosion to check on the slow match, as it had not detonated when expected. According to news correspondent William P. Doran, who witnessed the battle and compiled Confederate accounts for the paper, the boat had traveled "some distance away" before returning (Sioux 1876:2). The explosion from deep within the hold was devastating and described as causing *Westfield* "to part or burst out forward, like a chestnut burr" and split "fore and aft . . . like a book, crushing the gig with its crew awaiting at her side." The forward portion of the boat was immediately destroyed and burned or blown "to pieces" to the waterline (Baker 1882:24; Burt 1863; Scharf 1887:508). The testimony of a Confederate diver involved in the later salvage provides evidence that the vessel may have been blown in two. He ". . . found the wreck to consist of about one half of the hull of the vessel embedded in the sand and in about six feet of water—The decks were burned off of her forward [*sic*, aft] and the stern [*sic*, bow] part blown off about sixty yards . . ." (Appendix A-2, Letter 7).

The force of the explosion was immense (Figure 14). Pieces of the vessel including "sheets of iron, planks, shells, and missiles of every conceivable form and kind" were propelled a "radius of four or five hundred feet" (*New York Times* 1863; Scharf 1887:508). A Confederate witness told a reporter three decades later that the blast was heard 90 miles away (New York Times 1892:17; see John Quick account in Table 4). About 10 minutes after the magazine exploded, one witness reported "another flash, and she was speedily wrapped in flames" (Scharf 1887:507-508). The ship burned down to the waterline. Scharf might have referred to a boiler explosion; however, it is peculiar that no other witness reported a second explosion. Scharf described the magazine destruction as "a flash of blue smoke and a fearful explosion." His choice of the word "flash" as a precursor to the rapid spread of flames 10 minutes after the magazine explosion literally might have meant that flames flashed quickly across the ship. Perhaps the surviving decks, having been soaked with barrels of turpentine, took that long to ignite following the magazine explosion. There is no evidence to suggest that detonation of the aft magazine or destruction of the steam engine occurred at the time of the ship's loss. The tops of the boiler drums would have been at about 6 ft above the water when *Westfield* ran aground and quite possibly exposed by destruction of the surrounding cabin by the magazine explosion. A boiler explosion occurring simultaneously with the magazine destruction might not have been noteworthy and is a reasonable possibility. However, it seems unlikely that a boiler exploded 10 minutes after the magazine only to be noted by a single witness reporting 23 years after the event and referred to simply as “another flash.”

Commander Renshaw was killed instantly and at least 12 additional crew were lost (as many as 23 have been suggested, see Table 3). Quartermaster Charles Burrell was on the transport *Saxon* at the

FIGURE 14. DESTRUCTION OF *WESTFIELD* (DETAIL FROM *HARPER'S WEEKLY* 1863:73)

time of the explosion. He claimed to be so close to the destruction that he could see Renshaw “. . . rapidly ascending, and then coming down in small pieces. . .” (Cotham 1998:129). The Fleet Surgeon later reported 13 men as “missing,” including Commander William B. Renshaw, Lieutenant Charles W. Zimmerman, Acting Assistant Engineer W.R. Greene, Gunner’s Mate John Callahan, Quarter Gunner Samuel P. King, Coxswain W. Esson, Seamen Rodolphus C. Hibbard, Henry Bethke, and Peter Johnson, Ordinary Seaman Mathew McDonald, and Second-class Firemen Hugh McCabe, William F. Reeves, and George E. Cox (Foltz 1863).

Shortly after the destruction of *Westfield,* the rest of the Union fleet retreated from the bay with "their white flags still flying at their mast-heads" (Magruder 1863b:6). The brief Battle of Galveston was a total victory for the Confederates. Over 300 Union soldiers were captured along with the vessels *Harriet Lane, Elias Pike, Le Compte,* and *Cavallo*, and the flagship *Westfield* was destroyed. Union causalities were low, however, with only 26 reported as killed and 117 wounded (Cotham 1998:131–132). Following the battle, *Mary Boardman* and *Saxon* departed for New Orleans with the surviving crew of *Westfield* (Cotham 2006:130). Rear-Admiral Farragut immediately sent Commodore Bell, commanding officer of USS *Brooklyn*, to Galveston with the orders to retake *Harriet Lane* (Farragut 1863). Upon entering the bay 8 days after the battle, Bell (1863c) reported that the *Westfield*'s "smokestack and engines [were] still standing." Two days later, he reported that "the chimney and machinery of the *Westfield* are visible, standing erect" (Bell 1863c). Commodore Bell did not attempt to retake *Harriet Lane*; instead, he took up watch at the mouth of Galveston Bay and observed as Confederate forces reinforced their defenses and mounted additional guns at various points along the island. He stated there was "One ironclad battery of two guns left by Commander Renshaw at lower end of city near Old Hospital [north end]; one earthwork of two guns left by Commander Renshaw at the upper end of city [west end]" (Bell 1863c).

Table 5 presents a list of military and auxiliary vessels present in Galveston Bay during the Confederate recapture of January 1, 1863. A total of 17 vessels were involved in the events of the day, though only a few were directly engaged in the conflict. The Union fleet was composed of 11 vessels, which included 5 gunboats, 2 supply vessels, 2 transports, a pilot boat, and a mortar boat/schooner. In contrast, the Confederate Navy only boasted 1 gunboat, an armed schooner, and 3 transport vessels, 2 of which were armed. *Westfield* is the only Civil War loss known to have occurred in proximity to the location of 41GV151.

Confederate Salvage

Salvage of the wreck by the Confederate troops commenced just days following her destruction (see Appendix A-2). On January 3, General Magruder reported in a letter to General Cooper, the Adjutant and Inspector General, that the armament was just then being brought up from the water (Magruder 1863d). The *Houston Tri-Weekly Telegraph* (1863a) reported that the Confederate forces believed there was a "prospect of raising a large quantity of valuable iron and copper." The 13-inch-diameter wrought-iron paddlewheel shafts of *Westfield* also were raised and bored out to make guns. Under direction of the Confederate government, the hammered iron paddlewheel mainshaft was removed by Robert C. Railton and crafted into three 5¾-inch-bore rifled cannon of 10.5-ft length (Galveston Daily News 1899). Some accounts have stated, perhaps erroneously, that up to six guns were made from the shafts, and at least two of these guns were said to be 64-pounders capable of throwing a shot 6 miles (Marchand 1864; Seward 1864).

Table 5. Vessels at the Battle of Galveston, January 1, 1863

Vessel Name	Navy	Dimensions	Use	Type	Final Deposition
Bayou City	C.S.N.	165 x 28 x 5 ft	gunboat	steamboat, cottonclad	
Royal Yacht	C.S.N.		tender	schooner, yacht	Grounded on Redfish Bar
John F. Carr	C.S.N.		armed transport	steamboat	Wrecked in Matagorda Bay in early 1864
Lucy Gwinn	C.S.N.		transport vessel	sternwheel steamer	Surrendered at Matagorda Bay in May 1865, transferred to Mexican side of Rio Grande
Neptune	C.S.N.		armed transport	wood tug, cottonclad	Sank after ramming *Harriet Lane* in Galveston Bay, January 1, 1863
Cavallo	U.S.N.		supply vessel	bark	Captured by the C.S.N. in Galveston Bay on January 1, 1863
Corypheus	U.S.N.	72 x 20 x 6 ft	armed vessel	schooner, yacht	Sold in 1865
Clifton	U.S.N.		gunboat	converted ferry	Run aground and burned in March 1864
Elias Pike	U.S.N.		supply vessel	bark	Captured by the C.S.N. in Galveston Bay on January 1, 1863
Fairy	U.S.N.		mortar boat	schooner	Unknown
Harriet Lane	U.S.N.	180 x 30 x 10 ft	gunboat	sidewheel steamer, brig	Captured by C.S.N. Postwar conversion to a bark and renamed *Elliot Richie*; foundered off Pernambuco, Brazil, on May 13, 1884
Le Compte	U.S.N.		prize-pilotboat	schooner	Recaptured at Galveston on January 1, 1863; chased ashore at Galveston by the U.S.N. on May 24, 1865
Mary (Marion) P. Boardman	U.S.N.		transport	propeller steamboat	Transported *Westfield*'s crew from Galveston to New Orleans
Owasco	U.S.N.	158 ft 4 inch x 28 ft x 9 ft 6 inch	gunboat	steam propeller	Decommissioned and sold in 1865
Sachem	U.S.N.	121 ft x 23 ft 6 inch x 7 ft 6 inch	gunboat	two-masted steam propeller	Captured by the C.S.N. at Sabine Pass on September 8, 1863
Saxon	U.S.N.		transport	steam vessel	
Westfield	U.S.N.	215 ft x 35 ft x 13 ft 6 inch	gunboat	sidewheel ferry	Grounded and destroyed January 1, 1863, in Galveston Bay

Source: Silverstone (2001:39, 68, 72, 77, 174–176)

Early work at the vessel included the removal of the iron and copper from her upper works, two guns, and the steam stack. In May Colonel Sulakowski, Chief Engineer at Galveston, and Major Kellesburg of the Engineering Department hired Andrew Taylor and three assistants to continue salvage of the vessel. Each man was to receive one hundred dollars in gold bounty for every gun saved and proper salvage on all other items, though in actuality only a single hundred-dollar bounty was paid the salvers. Andrews and his men spent a month diving on the submerged wreck collecting any items of value that could be sold or used by the Confederate forces (Appendix A-2, Letter 7). The salvers found the vessel halfway buried in the sand with the forward [*sic*, aft] decks burned off and the main part of the stern [*sic*, bow] blown off around 60 yards from the main part of the wreck (Appendix A-2, Letter 7). Six of her seven guns were recovered, two of which were located approximately 30 ft from the wreck with their carriages, one of them overturned (*Houston Tri-Weekly Telegraph* 1863a). Objects removed from *Westfield* included (Confederate Prize Commission Records 1863):

- One 9-inch Dahlgren
- One 6-inch rifled gun
- Four 8-inch shell guns
- One Dahlgren carriage and portion of chassis
- Two damaged 8-inch gun carriages
- Complete tackle for six guns
- Two composition [brass] compresses
- Conical shot
- Over one-hundred twenty 8-inch shells
- 90 shells for rifled gun
- Twenty-one 13-inch shells
- Six gun tackle for ship carriages
- Two lifting rods
- One coppered rudder
- Two composition [brass] pintels
- Three dozen handcuffs
- A brass wheel
- 4-inch-diameter hawser
- Six coils of sisal rope, 540 ft to coil

- At least 1,400 pounds of brass
- More than 10,000 pounds of iron
- 3,300 pounds of boilerplate
- Two shafts, 10,000 pounds each
- One fighting bolt (for portable howitzers, bolt used to attach the barrel of the cannon to the carriage, used instead of trunnions)
- Four launches, one of which was a complete wreck
- Five barrels meat
- One barrel beans

NAVIGATION IMPROVEMENTS

The main concentration of *Westfield* wreckage was not located inside the designed channel prism until the TCC was widened northward to 400 ft in 1967. At that time, the TCC was expanded to its present dimensions of –40 ft USACE MLT (with allowable overdredging and advanced maintenance dredging to –45 ft USACE MLT) and 400 ft wide (Carolyn Murphy, personal communication 2005; U.S. Army, Secretary of the Army 2004:4–12). Most of the known wreckage is limited to the northern 100 ft of the channel as it exists today. Today, the bottom elevation at *Westfield* is –46 ft USACE MLT. This portion of the TCC remains below the channel's design grade through natural processes and has never required dredging. Although the site has not been directly affected by navigation improvements, the increase in water depth over *Westfield* from 1863 to the present is believed to be due largely to tidal scour accentuated by completion of the Galveston jetties in 1897 and by the Texas City Dike in 1915. Thus, the history of improvements to the TCC is relevant to the shaping of this archeological site over much of the period since it came to rest at this location.

The TCC was created following the establishment of the port of Texas City by August B. Wolvin in 1893. Wolvin, with Jacob, Henry, and Benjamin Myers and other Duluth shippers, purchased 7,000 acres of land in the 1890s (McComb 1986:152; Price 1941:44). After building a 1,000-ft, single-track trestle from the shore out into the bay, the Myers brothers petitioned Congress for permission to dredge a channel to their burgeoning port. Permission was granted on March 23, 1893, and shortly thereafter construction began on an 8-ft-deep channel from the Myers's property at Texas City to a connection with the main channel serving Galveston. Work on the channel was completed in April 1894 (Price 1941:44–45).

On April 24, 1895, the Myers brothers were granted permission by the Federal government to increase the depth of the newly built channel to 16 ft. The contract for this project, along with a separate contract to dredge the harbor area in front of the Texas City docks, was awarded to Linton W. Bates of Chicago in May 1895. Using a dredge that could handle 6,000 cubic yards

(4,587 cubic meters) of material a day (making it the largest dredge in the U.S. at the time), Bates completed the 16-ft channel on June 1, 1896 (Price 1941:45–47). That same year, the Morgan Line established the first regularly scheduled steamship service at Texas City, taking advantage of the deepened channel as well as the newly constructed slips, in order to transport cotton from Texas City to New York.

The initial creation of the TCC, though sanctioned by the Federal government, was financed through private interests. Direct government involvement with the TCC, prior to 1899, was otherwise limited to allowing the connection of the TCC to the federally funded and maintained Galveston Ship Channel (now the HGNC). With congressional passage of the Rivers and Harbors Act on March 3, 1899, however, the Federal government took a more direct role in the TCC project. The bill provided for deepening the channel to 25 ft and widening it to 100 ft at the bottom for those areas north of Pelican Island from Galveston Harbor to Texas City. The Federal government allocated $250,000 for completion of this project (Price 1941:49).

Dredging operations began in July 1900 but were quelled by the hurricane that hit on September 8 of that same year. The project was not completed until March 19, 1905, costing $338,000 more than the $250,000 provided by the government. The additional expense was covered by private funding (Price 1941:49). The channel was dredged to a depth of 25 ft and a width of 100 ft; however, no dredging was required near *Westfield* where the seabed had already scoured in excess of the channel's design depth. Scouring of the *Westfield* site might have been accelerated by completion of the Galveston jetties in 1897. By 1904 the site elevation had decreased to about –30 ft MLT (USACE 1905). In 1905 the USACE, impressed with the rapid development of the Texas City port, recommended that the Federal government take over responsibility of maintaining the TCC. Congress agreed, and in early 1905 began making annual appropriations for subsequent channel maintenance and improvement (Price 1941:50).

Following the devastating 1900 hurricane, local boat owners and captains plying the waters of Galveston Bay petitioned the War Department to remove dangerous navigation hazards in the western portion of the bay (U.S. Army, Department of Engineers 1905a, 1905b). The Office of the Chief of Engineers (predecessor to the USACE) responded and conducted a clean-up of navigation hazards in the bay as part of the river and harbor improvements for fiscal year 1905–1906. Towards this effort, the U.S. snag boat *Gen. S.M. Mansfield* was allotted $2,500 to remove wrecks in west Galveston Bay resulting from the 1900 hurricane. The U.S. Engineer Office in Galveston found it "not advisable to expend much money in a careful survey and estimate [of scattered wreckage]" (U.S. Army, Department of Engineers 1905c). Rather, "two months' work with a snagboat, relying on observation at the time and information from the local boat owners, will cover the cost of removing many of the most menacing obstructions" (U.S. Army, Department of Engineers 1905c).

The annual report of the Chief of Engineers for the fiscal year ending June 1906 (U.S. Army, Department of Engineers 1906:1351) reported that *Gen. S.M. Mansfield* "removed" the wreck of

Westfield in addition to all or part of four other wrecks and an assortment of other obstructions. It seems reasonable to suggest that *Gen. S.M. Mansfield* cleared the wreck to a depth satisfactory to the boat captains in the area. According to the *Galveston Daily News* (1906), the upright "engine shaft" (presumably the engine cylinder) was only 4 ft beneath the waterline. Assuming the top of the cylinder was 4 ft deep in 1906, and based on engine and boiler dimensions from a reconstruction of *Westfield's* machinery (Chapter 7), the tops of the boilers would have been 17 ft deep, the base of the steam engine 25 ft deep, and the base of the fireboxes (the lowest point on the boilers) would have been about 27 ft below the surface. Water depth near *Westfield* was charted at 30 ft deep in 1904 (USACE 1905), so clearly the demolition divers had full access to both the engine and the boilers when conducting their work. The *Galveston Daily News* (1906) reported the wreck was in 18 ft of water at the time, consistent with the estimated 17-ft depth of the boiler tops (above).

The shaft was removed as well as large quantities of copper and brass. The hull of the gunboat was observed to have mostly rotted away. Only about 3 feet of vertical hull structure would have remained beneath the boiler room floor by this time. The wreckage, presumed to have been mostly parts of the boilers and engine, was brought up by dynamiting. The explosives were placed by a diver and detonated remotely with electric wires from the *General S.M. Mansfield* (Figure 15), a government owned dredge and snag boat measuring 125 x 26 ft (*Galveston Daily News* 1906). The first explosion sent water and wreckage 200 ft into the air and killed thousands of fish (*Galveston Daily News* 1906). Atkins conducted research to locate operating logs for the *General S.M. Mansfield* dating to this time period but was informed by a National Archives and Records Administration archivist that the USACE schedule likely categorized these records as nonpermanent (Rodney Krajca, personal communication 2005). Nonpermanent records are destroyed when superseded or obsolete.

Over the next few years, the new Texas City Company and Texas City Transportation Company financed port facilities, including new warehouses, cotton compresses, grain elevators, railroad tracks, a turning basin, and an oil-loading pier (Price 1941:51–53). With these improvements in the size and efficiency of Texas City's port, the dimensions of the existing channel became insufficient. On August 18, 1910, bidding was opened for a Federal contract to dredge the TCC to a depth of 27 ft and a bottom width of 200 ft. Work was completed on June 29, 1911; however, Congress quickly realized that the new dimensions were still inadequate to support the ship traffic into Texas City. On March 4, 1913, another project was ordered, this time to bring the channel to a depth of 30 ft and a width of 300 ft. Bowers Southern Dredging Company completed this project on May 12, 1916. Expansion of the TCC to its present dimensions of –40 ft USACE MLT (with allowable over-dredging and advanced maintenance dredging to –45 ft USACE MLT) and 400 ft wide occurred in 1967 (Borgens, Hudson et al. 2007:13; U.S. Army, Secretary of the Army 2004:4–12).

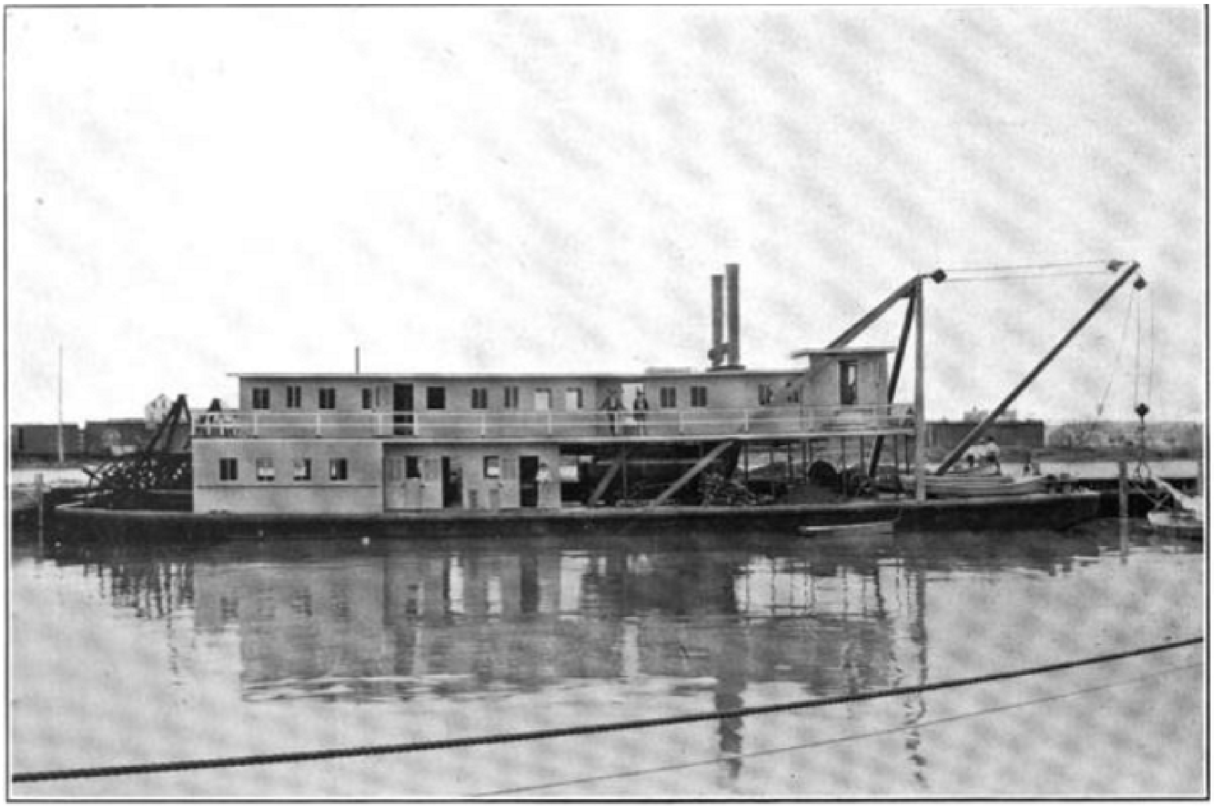


FIGURE 15: DREDGE/SNAG BOAT *GENERAL S.M. MANSFIELD*.
(U.S. Army, Department of Engineers 1905d:3034-3035).

Due to heavy sedimentation caused by river and bayou drainage into Galveston Bay, the early maintenance of the channel at Texas City became futile. Congress passed an act on March 4, 1913, appropriating $1,400,000 for construction of a covered pile dike. The creation of the new dike would help alleviate the accumulation of sediment in the TCC. William Moore constructed the dike between May 2, 1914, and May 3, 1915. When it was completed, the Texas City Dike covered a length of approximately 28,200 ft, from Shoal Point, about 1 mile north of Texas City Harbor, and through the extent of the channel (Price 1941:55). Between 1931 and 1934, the pile dike was replaced with a rubble-mound structure, and in 1940 a second dike, of the same construction, was built north of the original one. The area between the two dikes was then filled with earth, creating the structure that is in place today.

3

PHYSICAL ENVIRONMENT

USS *Westfield* was destroyed as it laid aground in 7 ft of water on a shoal northwest of historic, now-submerged, Pelican Spit. The remains of *Westfield* were visible for 23 years following the Battle of Galveston until the “boiler” disappeared from view during a hurricane. Today the site rests on a layer of resistant marine clay at a depth of 47 ft, a full 40 ft deeper than when the ship ran aground. Pronounced hydrological and biological processes at the wreck site have greatly altered the physical environment, contributing to the complete degradation of the ship’s hull. The location of *Westfield* is adjacent and roughly parallel to the north margin of the TCC near its juncture with the HGNC. This is one of the busiest intersections for ship traffic in the world. Traffic on the HGNC averages more than 50 ships and 300 barges per day (Houston/Galveston Navigation Safety Advisory Committee 2008). Traffic on the TCC is significantly less than on the HGNC, although the Port of Texas City ranks eighth out of 153 ports in the United States, in terms of tonnage, exceeding 78 million net tons per year (Port of Texas City and Texas City Terminal Railway Company 2010).

HISTORIC CHANGES TO THE LANDSCAPE

When *Westfield* ran aground in 1863, Pelican Island was considerably smaller than today; neither the Galveston Jetties nor the Texas City Dike existed, and no channel dredging had yet occurred in lower Galveston Bay. Bathymetry fluctuated annually as sands of the tidal delta migrated in response to storms and precipitation patterns. In 1820 Pelican Island was merely a shell bank with some vegetation, but by 1851, a smaller island named Pelican Spit had formed between Pelican Island and Galveston Island (Alperin 1977:26). Pelican Spit later merged with Pelican Island (Figure 16), but during the Civil War it was a separate island and was the location of Fort Jackson. Fort Jackson included barracks that were occupied by Union troops during their brief possession of Galveston. Prior to 1888, the water between Pelican Spit and Pelican Island could be crossed on foot at low tide, and by that date Pelican Island and Pelican Spit had merged into a single land mass (USACE 1888 and Figure 16).

Around 1905 new land was created along the northern margin of the Galveston Channel using dredged material (USACE 1905). The southern shore of the present Pelican Island began to take shape there by 1909 (Figure 16 and U.S. Coast and Geodetic Survey [USCGS] 1909). The enlarged island was initially referred to as Pelican Spit. The terms Pelican Spit and Pelican Island were sometimes used interchangeably to describe the same landforms into the early twentieth century,

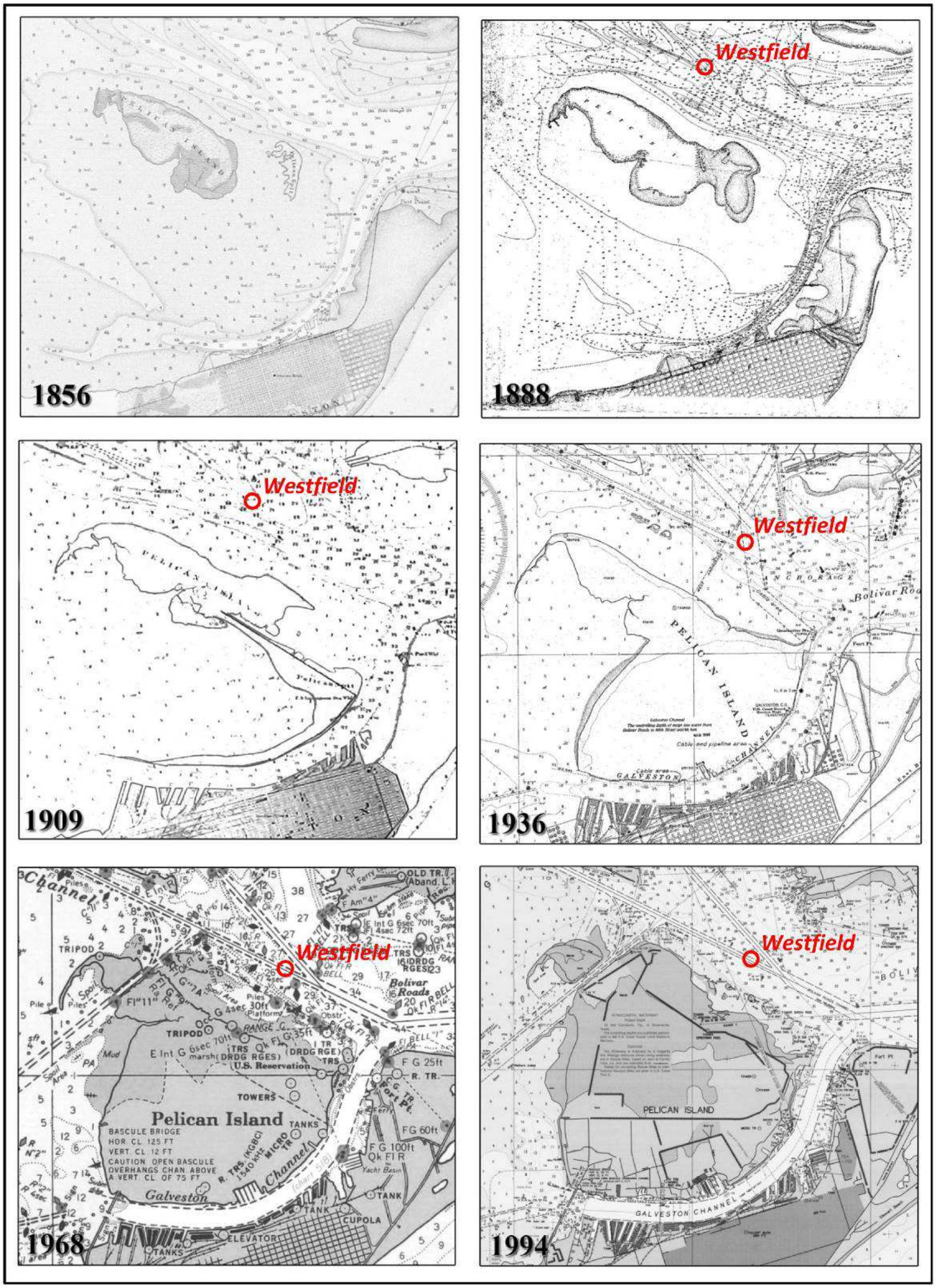


FIGURE 16. LANDFORM CHANGES NEAR USS *WESTFIELD* (FROM BORGENS ET AL. 2007)
U.S. COAST SURVEY (USCS 1856), USACE (1888), USCGS (1909, 1936, 1968), AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA 1994)

although most of what was originally Pelican Spit eroded into Galveston Bay between 1909 and 1936 (see Figure 16). By midcentury, annual dredging of the Galveston wharves was largely responsible for the territorial increase of Pelican Island. Ersel Lance, engineer for the Galveston Wharves, asserted in 1952 that "Pelican [Island] was practically built from the dredging." By September 1956, half of 4,000,000 yards of dredged material had already been deposited (*Galveston Daily News* 1956). Today the name Pelican Spit has been dropped from maps completely.

GEOLOGY

A geological assessment of the *Westfield* site (Appendix B) was conducted by Dr. Tim Dellapena for Atkins and the USACE in order to provide a geologic context for the sediments upon which the site rested, as well as for the sediments that have eroded from beneath the site since it ran aground (Dellapena 2009). Portions of this section are based on Dellapena's assessment. *Westfield* was located within the Pleistocene-era Trinity River Valley trench in the entrance to Galveston Bay, a part of the bay also known as Bolivar Roads. The Trinity River Valley was eroded deeply through Bolivar Roads during the most recent ice age when sea level was lower than today. Rising sea levels inundated the mouth of the valley following the Pleistocene, forming the estuary that is now Galveston Bay. Dellapena states that the Trinity River Valley in the vicinity of the site was inundated about 9600 years before present (BP) when Galveston Bay began to form. Since that time the drowned valley has gradually filled with sediment. Between 9600 and 7400 BP the site area likely was covered by bayhead delta sediments, after which deposition alternated between open bay muds and tidal delta sands (Dellapena 2009; Appendix B). The results of diver probes into sediments underlying the site were consistent with thin, alternating layers of dense, fine-grained, clayey sediments (bay mud) and sandier transgressive sediments. As many as four layers of dense, clayey sediments were encountered within 10 ft of the seafloor beneath the site, including the one upon which the site rests. The clay substrate underlying the site was exposed in small areas of the site or buried by a thin layer of fine sandy sediment topped by about 6 inches of shell hash (defined as a residual accumulation of coarse, unconsolidated rock and mineral debris left behind by the winnowing of finer material).

The filled Trinity River Valley is about 8 miles wide (13 kilometers [km]) and extends down 180 ft below sea level at its deepest point beneath Bolivar Roads. *Westfield* was situated about 1.9 miles from the southwestern margin of this paleo-valley (Gulf of Mexico Research Group 2000). Outside the ancient Trinity River Valley, the Beaumont Formation occurs 39 ft below sea level beneath Galveston Island, and then slopes gently upward as the mainland is approached (Gulf of Mexico Research Group 2000).

Sub-bottom profile data collected over the site by Atkins in 2006 recorded the sedimentary sequence from the seafloor down to the former Pleistocene land surface (Figure 17). Sedimentary interpretations of this sequence are based on two seismic cross sections of the lower bay,

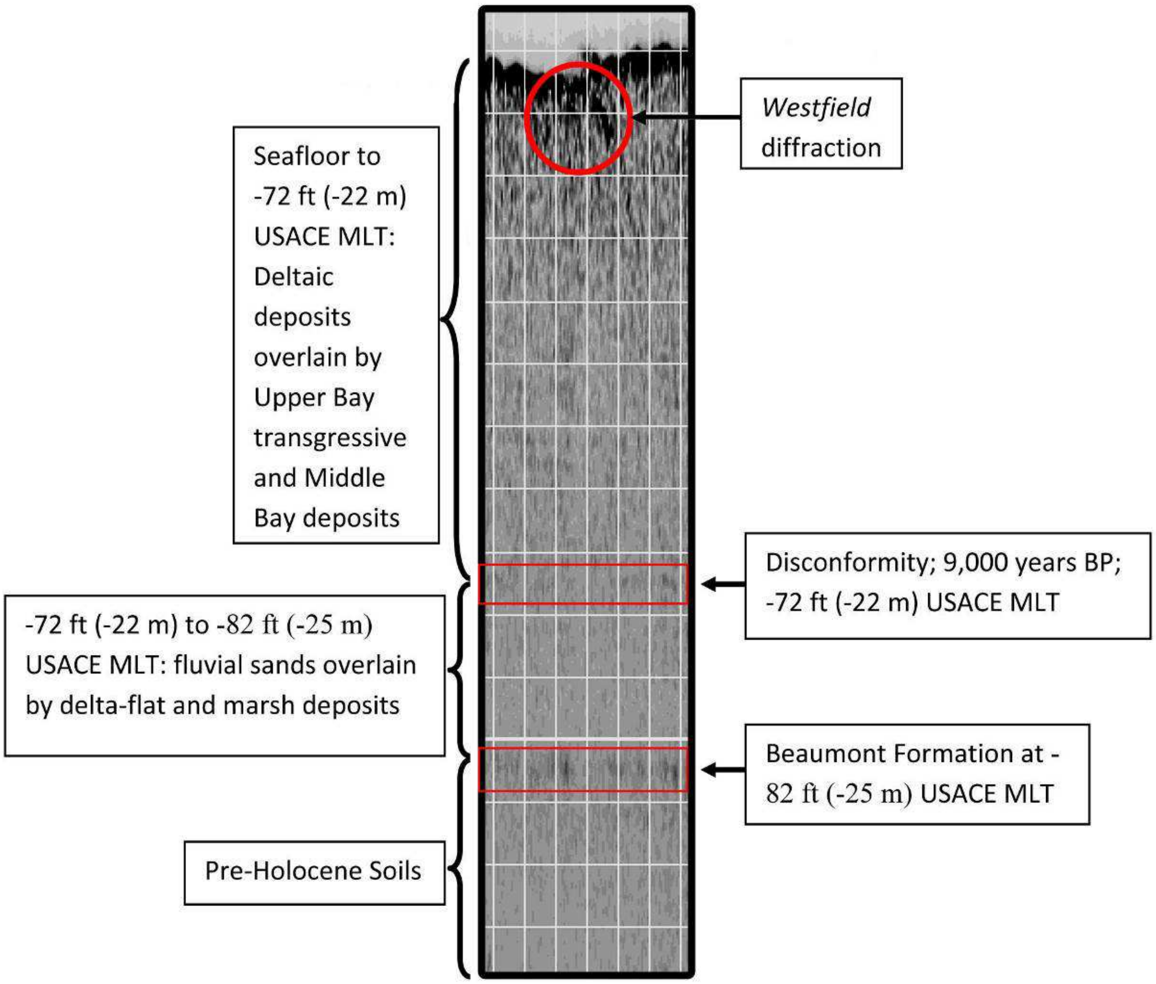


FIGURE 17. CHIRP SUB-BOTTOM PROFILE RECORD SHOWING *WESTFIELD* ABOVE A POSSIBLE PLEISTOCENE LAND SURFACE KNOWN REGIONALLY AS THE BEAUMONT FORMATION. HORIZONTAL SCALE LINES ARE AT 1-M INTERVALS. TYPICAL 10-FT AND 6-FT DIVER PROBE DEPTHS ARE SHOWN AS ORANGE BARS ON EITHER SIDE OF THE PROFILE. SEDIMENT INTERPRETATIONS BASED ON REHKEMPER (1969:40–43)

supplemented by sediment cores (Rehkemper 1969:40–43). One of Rehkemper's cross sections extended west-east from Dollar Point to Bolivar Peninsula. The other ran north-south across Bolivar Roads from Bolivar Peninsula to Galveston. Rehkemper interpreted an abrupt transition from mid-bay to inlet-beach deposits at depths of roughly 40 and 50 ft beneath those two respective profiles. The clayey substrate beneath *Westfield* is believed to represent that same transition. Remnants of sediment overlying the clay (above –46.9 ft USACE MLT), as well as all sediment that has eroded from the site since 1863, likely was part of the flood tide delta. Sediments between the present seafloor and –72 ft USACE MLT are interpreted as middle bay muds, overlying upper bay materials deposited during a period of rising sea level, over bayhead delta deposits. Several faint reflectors (see Figure 17) might represent estuarine clay deposits. A disconformity at

–72 ft USACE MLT was carbon dated at 9,000 years BP (Rehkemper 1969:43). That break is believed to be the most recent (Holocene) subaerial land surface prior to inundation by an early Galveston Bay. Beneath the disconformity are 10 ft of delta-flat and marsh deposits over fluvial sands. Finally a buried reflector at an elevation of –82 ft USACE MLT is interpreted as the Pleistocene subaerial land surface, known regionally as the Beaumont Formation.

CURRENTS

Galveston Bay receives outflow from the San Jacinto and Trinity rivers and local drainage from the City of Houston via Buffalo Bayou and the Houston Ship Channel. The bay has three tidal inlets, though only two, Bolivar Roads and San Luis Pass, are major influences with regard to tidal flow. Bolivar Roads, the location of the wreck site, between Pelican Island and Bolivar Peninsula accounts for 83.5 percent of the tidal inflow and 92.6 percent of the outflow between Galveston Bay and the Gulf of Mexico (Matsumoto et al. 2005:62). Unlike much of the Gulf Coast that has diurnal tidal currents (one flood, one ebb), the entrance to Galveston Bay is both diurnal and sub-diurnal wherein there is one flood and one ebb tide each day when the moon is near its maximum declination and two of each on the days when the moon is near the quarter (Bowditch 1995:155). Tidal currents have affected the archeology of *Westfield* in two significant ways. First, tidal currents presented a major obstacle to conducting archeological field investigations on the site, and second, erosion of the site was largely attributable to current, in combination with manmade alterations of the landscape, designed in part to harness the current for deepening the harbor entrance.

Maximum tidal velocities through Bolivar Roads, under normal conditions (at a depth of 31 ft), are +2.8 mph flood and –2.1 mph ebb (National Oceanic and Atmospheric Administration [NOAA] 2009). Average peak velocity through Bolivar Roads during flood tide (1.4 mph) is 20 percent greater than during ebb tide (1.2 mph). Diver operations become increasingly difficult and inefficient as the current velocity approaches 1.2 mph. The force of a 1.2-mph tidal current is equivalent to that of a 34-mph wind (Gearhart et al. 2010:34–35), except that the diver is buoyant so does not have the full benefit of body weight to anchor his position. Windows of opportunity for diving at suitable currents were limited to a few hours each day. For example, during the 2006 NRHP assessment diving, Atkins archeologists achieved only 37.5 hours of bottom time over a 12-day period. Of that time, 5 hours was done at current velocities exceeding 1.2 mph, during which even simple tasks included a struggle by the diver simply to hold position on the seafloor against the current. The average bottom time each day was slightly more than 3 hours per day, which allowed for only two to three dives per day.

Peak currents through Bolivar Roads are normally swift enough to cause scour of sandy sediments (e.g., Hughes 1999); however, the erosive potential of currents can be substantially greater during tropical storms and hurricanes. Unfortunately, no reliable velocity estimates for storm surge through Bolivar Roads were located by the time of this writing. Zevenbergen et al. (2004:5.8, Figure 5.1) illustrate "typical" storm surge velocities of about +4.0 mph flood to –5.6 mph ebb, although such values might not be representative of Bolivar Roads. During a hurricane that struck Galveston Bay in 1877, the ebb velocity was estimated at –3.4 mph as a 6.5-ft surge flowed out of the bay (U.S. House of Representatives 1886:1300), so one might suppose that any storm tide exceeding that height would have a comparable ebb velocity. While 3.4 mph may not sound particularly swift, a current of such velocity would carry a force equivalent to that of a 96-mph wind (Gearhart et al. 2010:34–35). Currents of such magnitude are capable of substantial scour (e.g., Hughes 1999).

The most important characteristic of storms affecting *Westfield* is the height of the surge entering Galveston Bay as this will determine the duration and velocity of current flowing past the site. Prior to construction of the seawall in 1902, Galveston was frequently and easily flooded, so it is difficult to estimate surge height from general descriptions of early storms, such as provided in Roth (2000). Aggarwal (2004:61) used the ADCIRC computer program (Luettich et al. 1992) to estimate surge height for several early storms, thereby providing some basis for comparison of their erosive potential. Aggarwal compared the ADCIRC modeled estimates with available measurements reported by NOAA's National Ocean Service (NOS). His results are reproduced in Table 6. Relative surge heights at Clear Lake should roughly reflect the volume of water in the bay that would subsequently flow past *Westfield* on its return to the Gulf of Mexico. Surge heights for the Galveston Pleasure Pier, which is located on the Gulf side of Galveston Island, are included in Table 6 to demonstrate that water levels may be substantially higher or lower in the bay than reported in Galveston, depending on the storm path.

EROSION OF THE SITE

Forty feet of sediment has eroded from beneath the *Westfield* site since it ran aground in 1863. The downward migration of *Westfield* is clearly documented by changing water depths in historic hydrographic charts (figures 18 and 19). At the time of the wreck event, one end of the ship was reportedly grounded in 7 ft of water. The sand bar upon which *Westfield* grounded is believed to be part of the flood tidal delta of the Galveston Bay inlet (Dellapena 2009). This bar is consistently illustrated as a linear shoal on the southwestern side of the wreck on historic charts (see figures 18 and 19). The shoal in every case is more or less parallel to the modern alignment of the TCC. A chart by Boyd (1867) shows a "Steam Drum or Smkstk" visible 4 years after the wreck and salvage of *Westfield* (Figure 18c). For the next 10 years the nearest soundings were charted as 8 to 10 ft (Boyd 1867; U.S. Coast Survey [USCS] 1877). An 1877 USCS chart depicts the "boiler" still above water 14 years after the battle (Figure 19b). The "boiler" remained visible for 23 years following the wreck event, before reportedly sinking in 1886 during a hurricane that submerged Galveston Island (Ziegler 1938:240). By 1896 the depth of the sand bar near the site was charted at 12.5 ft (USCGS 1899).

TABLE 6. STORM SURGE ESTIMATES FOR GALVESTON HURRICANES

Hurricane No./Name	Date of Storm	Galveston Pleasure Pier (meters MSL)		Clear Lake shores (meters MSL)	
		ADCIRC	NOS	ADCIRC	NOS
1. #5	8/12/1886	0.796		1.068	
2. #117	8/27/1900	2.141		1.216	
3. #183	7/13/1909	1.493		1.475	
4. #211	8/5/1915	3.059		3.369	
5. #232	8/1/1918	0.78		0	
6. #295	6/27/1929	1.875		1.123	
7. #310	8/12/1932	3.04		3.923	
8. #324	7/25/1933	0.689		0.688	
9. #397	8/2/1940	0.264		0.37	
10. #405	9/16/1941	2.155		3.234	
11. #445	8/24/1945	1.002		2.391	
12. #565 – Audrey	6/25/1957	0.516		0.514	
13. #586 – Debra	7/23/1959	1.105	0.954	2.64	
14. #602 – Carla	9/3/1961	2.314	2.46	3.811	
15. #690 – Celia	7/31/1970	0.952	0.91	1.466	
16. #703 – Edith	9/5/1971	1.158	1.25	1.172	
17. #704 – Fern	9/3/1971	1.477	1.32	2.067	
18. #722 – Delia	9/1/1973	1.227	1.14	1.965	
19. #809 – Chris	9/9/1982	0.434	0.401	0.553	
20. #812 – Alicia	8/15/1983	-	-	-	-
21. #841 – Bonnie	6/23/1986	0.431	0.69	0.511	
22. #867 – Chantal	7/30/1989	0.593	0.682	0.459	
23. #874 – Jerry	10/12/1989	1.39	0.997	1.869	
24. #923 – Dean	7/28/1995	0.859	0.84	1.177	0.985
25. #965 – Frances	9/8/1998	0.791	0.84	1.15	1.31
26. #1001 – Allison	6/5/2001	0.605	0.792	0.81	0.985
27. #1016 – Claudette	7/5/2003	1.481	1.523	1.595	1.563
28. Ike	9/13/2008		3.29		3.87

Hurricane Number from Jarvinen et al. (1988), as cited in Aggarwal (2004)

ADCIRC (modeled) and NOS (measured) values from Aggarwal (2004:61–62) except Ike from NOAA (2008).

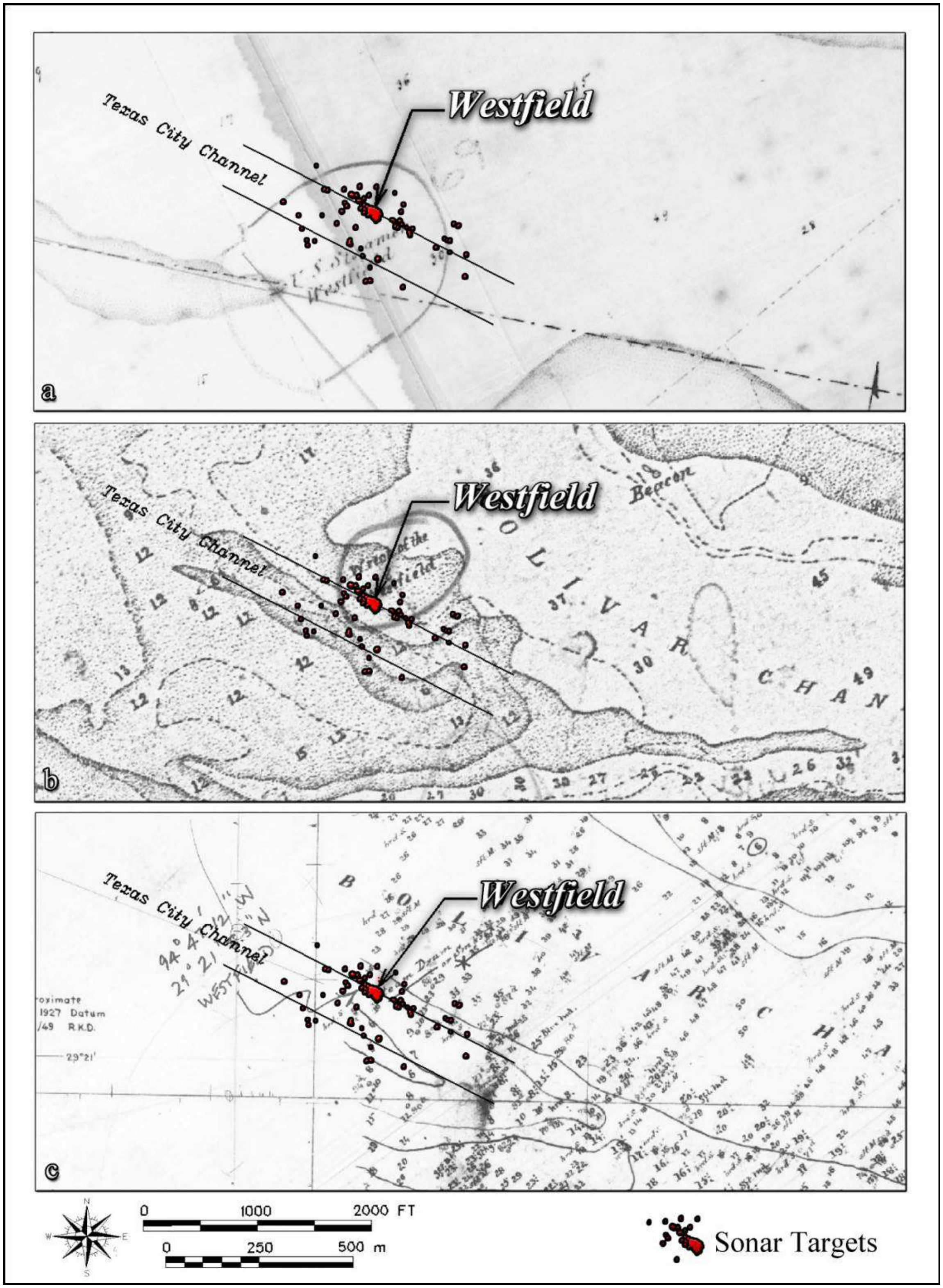


FIGURE 18. GEO-REFERENCED HISTORIC CHARTS 1865-1867.
(A) (UNIDENTIFIED C. 1865); (B) (MCGREGORY 1865); AND (C) (BOYD 1867)

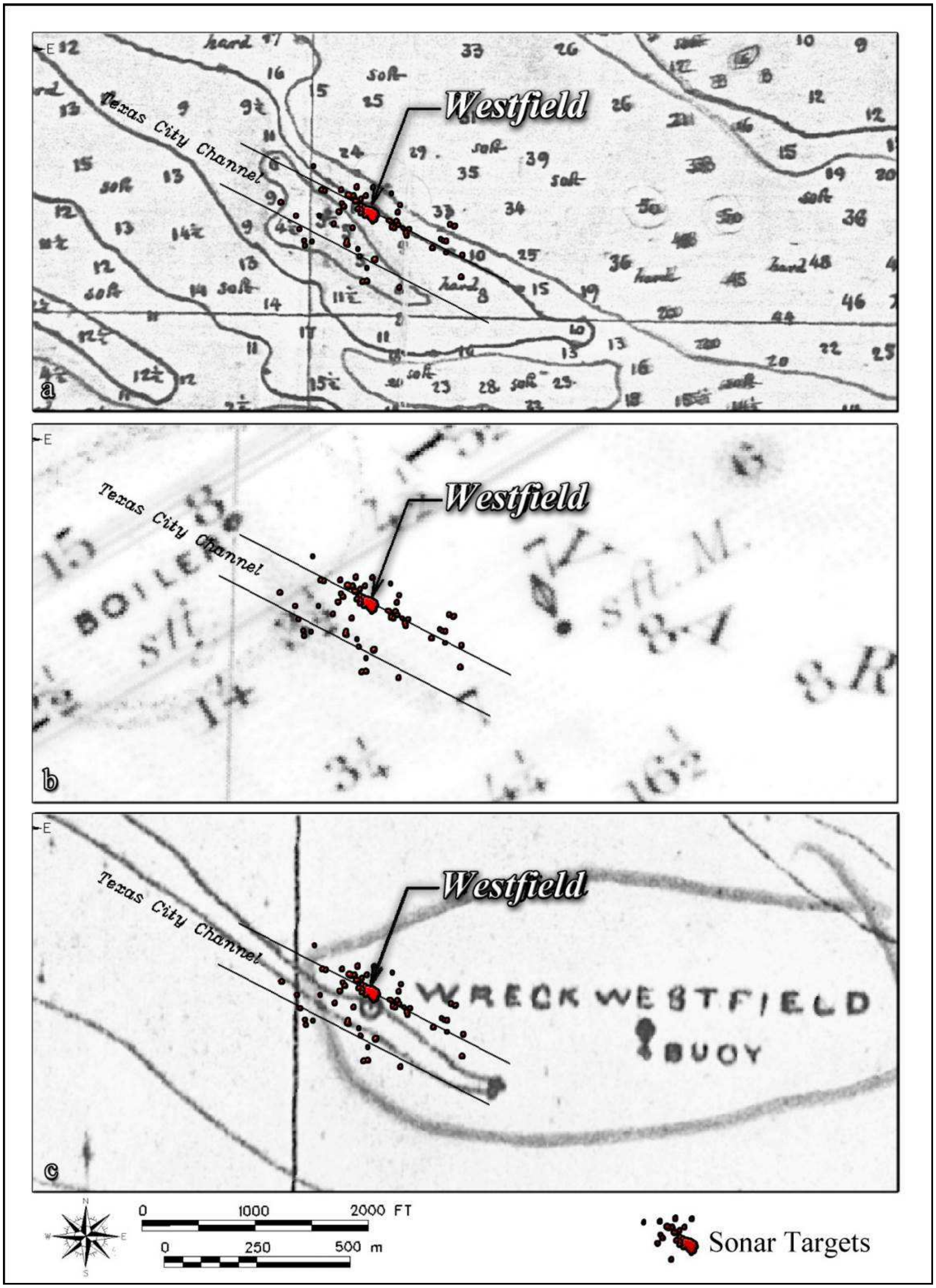


FIGURE 19. GEO-REFERENCED HISTORIC CHARTS 1868-1877.
(A) (STANTON 1868); (B) (USCS 1877); AND (C) (HOWELL 1877)

The erosion history of the site is illustrated on Figure 20. The rate of erosion appears to have been relatively constant for much of the site's history except for roughly 20 years of rapid erosion from 1896 to 1917. Early erosion of the site might be attributable to scour induced by the wreck itself. Prior to 1876 the tidal regime was unaltered from its natural state, and left alone the flood tidal delta might have remained relatively stable. The very presence of the wreck, combined with the introduction of various improvements to Galveston Bay navigation, which altered the natural current regime, likely affected erosion and deposition rates at the site in complex ways.

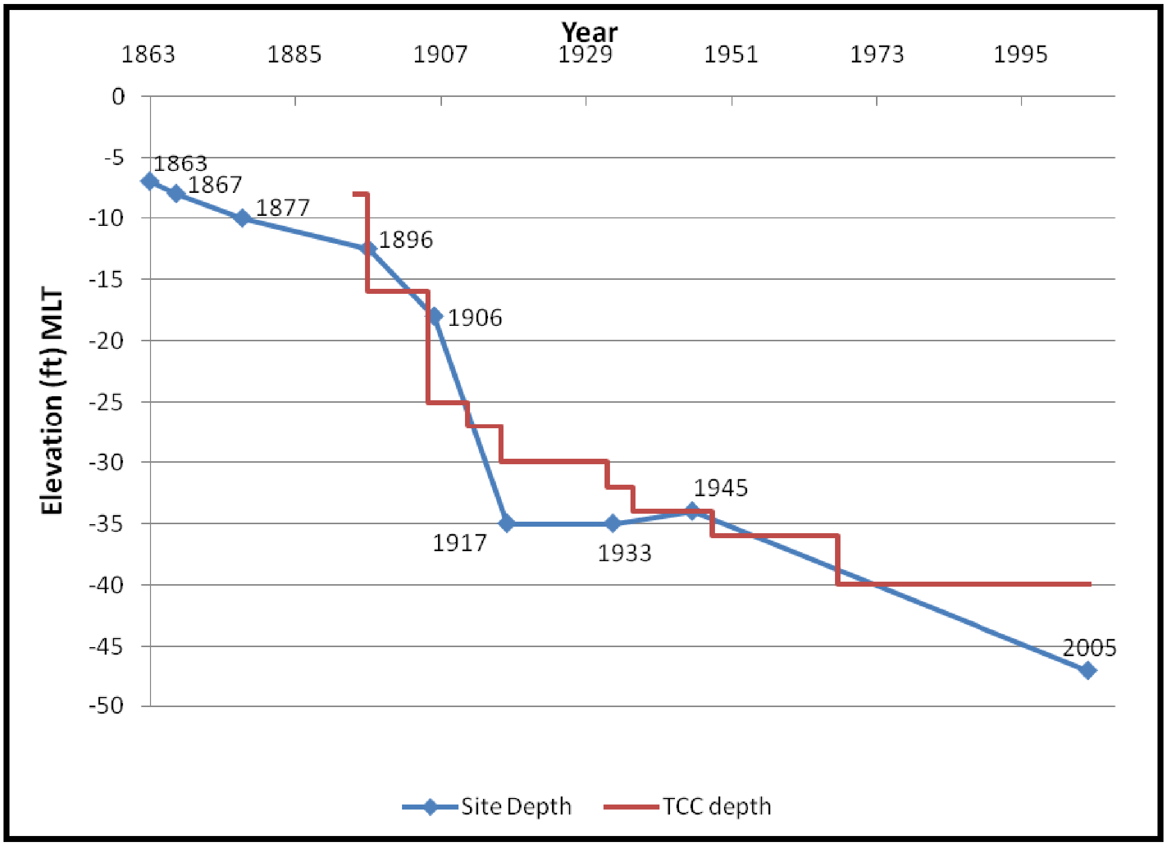


FIGURE 20. HISTORY OF SITE EROSION AND TCC DREDGING.

1863–1896

The rate of site erosion during the first 33 years following the wreck event averaged about 2.0 inches per year. That period also saw the beginning of improvements to navigation. The first dredged channel across upper Galveston Bay was completed by Charles Morgan in 1876 (Alperin 1977), and in 1889 the USACE completed a 12-ft-deep extension of Morgan's channel across the lower bay. Then in 1894, the TCC was first dredged to a depth of 8 ft (Price 1941:44–45), although the channel at that time was 300 ft south of the wreck. Computer modeling of bay circulation (Matsumoto et al. 2005) concluded that removal of all the ship channels in Galveston Bay actually would increase the net flow through the Galveston Entrance Channel by 5.3 percent, so dredging of the channels might have slightly reduced the average current velocity through Bolivar Roads.

Nevertheless, dredging of the TCC likely affected the shoal on which *Westfield* grounded by diverting ebb current across the sandbar. During this early period of erosion, Galveston was affected by seven hurricanes or tropical storms including: a storm in 1867 that inundated Galveston and nearly demolished the wharves; an 1871 storm that inundated the east end of Galveston Island; a 10-ft storm tide reported in 1875; an 1877 storm with a 5.2-ft tide (U.S. House of Representatives [1886:1300] says 6.5 ft); a storm in 1886 that submerged Galveston Island (it was during this storm that *Westfield*'s boilers finally disappeared below the surface); an 1888 storm with unspecified damages; and another in 1891 that inundated part of Galveston (Roth 2000).

Erosion during this period was probably due mainly to hydraulic jump, which occurs when turbulent flow scours around an object protruding above the seafloor (Dellapena 2009; Appendix B-1). The role of scour in shipwreck site formation has been modeled by Quinn (2006) for various hull orientations and current regimes. For a hull oriented nearly parallel to the current, such as *Westfield*, a linear scour forms off the downstream end of the vessel following the alignment of the current. The direction of the flood tide, as measured by the Bolivar Roads tide gauge (NOAA 2009) near *Westfield*, is 306 degrees (at a depth of 31 ft). Examination of mid-nineteenth-century charts, shows that the sandbar on which *Westfield* grounded had roughly that same orientation, as would be expected for a flood tidal delta feature. Early flood tide scour induced by the hull should have paralleled the sand bar, causing it to deepen along its north side, upstream from the wreck, and perhaps reducing its width. Today the ebb tide flows across the site along a heading of 115 degrees, nearly parallel with the TCC. Prior to 1894 the ebb current likely flowed parallel to the sand bar. The difference is minor, only 11 degrees, but once the ebb direction came under the influence of the TCC, the outgoing tide would begin to cut through the sandbar south of the site. Following 1894, lateral scouring along the north side of the TCC probably further reduced the width of the bar remaining on the south side of the wreck.

Gradual scour likely occurred on a daily basis during the peak flow of both flood and ebb tides. Scour would have occurred both upstream and downstream from the site resulting from lee wake vortices generated over the exposed hull (Quinn 2006:1420–1421). It is conceivable that a wake vortex scour pattern extended for several hundred feet in either direction from the hull, although scour should have been deeper and broader on the bay side than on the seaward side, since the normal flood tide is 20 percent swifter than the ebb tide. Faster currents, associated with storm surge during hurricanes, would have accelerated the scour rate for brief but intense periods.

Localized scour also would occur immediately adjacent to the hull due to horseshoe vortices generated along the upstream side of the hull (Quinn 2006:1420–1423). Scouring by horseshoe vortices would have contributed to settlement and burial of the hull (Garcia 2002; McNinch et al. 2001:25). As the scour front grows laterally and begins to undercut the object, the shoulders of the scour underlying the object shear into the hole and are removed by the current. This is somewhat analogous to destabilizing a hillside by cutting away the toe of its slope. Simultaneously, the weight of the hull presses saturated underlying sediments laterally toward the scour hole. As sediment slowly presses into the hole from beneath the hull, where the interstitial pressure is highest, horseshoe vortices carry the new material out of the hole until the hull is buried to a depth of equilibrium.

1896–1917

The period from 1896 to 1917 saw a rapid increase in erosion of the site. The elevation was charted as –12.5 ft USACE MLT in 1896 (USCGS 1899). Within 10 years the site elevation had decreased to –18 ft USACE MLT (*Galveston Daily News* 1906), and by 1917 the elevation was –35 ft USACE MLT (USCGS 1918). The erosion rate averaged 7.3 inches per year from 1896 to 1906 and 1.5 ft per year from 1906 to 1917 (the steepest part of the curve on Figure 20). The accelerated erosion rate is believed due to several factors, including repeated enlargements of the TCC, completion of the Galveston Jetties, construction of the first Texas City Dike, and increasing the size of Pelican Island.

The TCC was deepened to 16 ft in 1896 (Price 1941:45–47), which likely increased the focus of ebb tide currents across the sandbar just south of the site. Then in 1897 the Galveston Jetties were completed for the very purpose of scouring and maintaining the Entrance Channel to a greater depth without the need for dredging. In 1905 the TCC was deepened to 25 ft and widened to 100 ft (Price 1941:49). The great hurricane of 1900 was the only storm reported between 1896 and 1906. Although it was one of the greatest disasters in U.S. history, hydrodynamic modeling by Aggarwal (2004:61–62), suggests the 1900 storm surge in Galveston Bay was not as high as that of the 1877 storm described above, so the level of site erosion due solely to the 1900 storm should not have been remarkable by comparison with storms of the earlier period of lower erosion. It seems more likely that dredging of the TCC and construction of the Galveston Jetties were the main causes of accelerated erosion at the site.

In 1906 the USACE removed portions of the site using divers, dynamite, and a snagboat. The annual report of the Chief of Engineers for the fiscal year ending June 1906 (U.S. Army, Department of Engineers 1906:1351) reported that *Gen. S.M. Mansfield* "removed" the wreck of *Westfield.* The following newspaper account provides all the detail known of this event, as the work logs of the snagboat are believed destroyed (Rodney Krajca, personal communication 2005).

> The wreck lies . . . in eighteen feet of water. The Government snagboat Mansfield, while recently engaged in searching for the wreck, ran against the engine shaft [piston cylinder?] of the Westfield, which was standing upright, the upper end not over four feet below the surface of the water. Since then the Mansfield has been at work removing the wreckage. The shaft has been removed, and also large quantities of copper and brass. Most of the timbers above the bottom of the bay have rotted away. The wreckage is being brought up by dynamiting, the explosives being set off with electric wires manipulated from the Mansfield. Diver Bryant is exploring the depths and placing the dynamite. (*Galveston Daily News* 1906)

There was no mention of the cannon being discovered in 1906, so it was presumably buried at the time. The fact that an intact hull was no longer visible suggests that scour induced by wreckage was, by this point in time, limited to localized areas downstream of individual objects, such as the boilers. Such scour might have periodically exposed interior hull features to biological degradation. Removal or breaking up of large objects by *Gen. S.M. Mansfield* probably had little effect on the rate of site erosion, since the bulk of the remaining hull was already buried. If any effect was caused by this work, it likely would have been to diminish the scour rate, since high points of the wreck were presumably leveled off or lowered, if not completely removed.

From 1906 to 1917, the average rate of erosion peaked at 1.5 ft per year. This period was preceded immediately (in 1905) by deepening of the TCC to 25 ft and widening to 100 ft (Price 1941:49). July of 1909 brought a hurricane to Galveston Bay with a storm tide possibly exceeding that of the 1900 storm. Aggarwal (2004:61–62) estimated the tide at 4.8 ft. It was also in 1909 that the enlargement of Pelican Island was begun using material dredged from nearby channels. The filling of Pelican Island had the effect of narrowing the bay cross section just inside the inlet. Ebb tides that once flowed across the area now occupied by Pelican Island were forced either through Bolivar Roads or the Galveston Channel. In 1911 the TCC was widened to 200 ft, within 100 ft of the *Westfield* hull, and deepened to 27 ft. In 1915 the Texas City Dike was completed. Matsumoto et al. (2005:63) concluded that the presence of the dike increased flow through the Entrance Channel by 1.2 percent.

In August 1915, Galveston was struck by a large hurricane. The storm tide at Clear Lake was estimated by Aggarwal (2004:61–62) at 11.1 ft (nearly as high as the 12.7-ft tide caused there by Hurricane Ike (NOAA 2008)). Then in 1916 the TCC was dredged to 30 ft deep and widened to 300 ft. The northern margin of the channel at this point would have been adjacent to the southern limits of the former hull location, although *Westfield* likely had been scoured below that depth by 1916, since only a year later the site was 35 ft deep.

1917–2005

The erosion rate from 1917 to 2005 averaged 1.6 inches per year, although the depth seemed to have stabilized until the mid-twentieth century. The requirements of deeper-draft vessels continued to require expansion of the TCC both in depth and width. The channel was deepened four times between 1917 and 1967. In 1967 the TCC was deepened to –40 ft USACE MLT and widened to 400 ft. Prior to 1967 the site was located north of the TCC. By the time the channel expanded to incorporate *Westfield*, the site had already scoured to a depth exceeding the new dredging, thus the site has never been dredged (Carolyn Murphy, personal communication 2005; U.S. Army, Secretary of the Army 2004:4–12). When the site was discovered by archeologists in 2005, the lowest elevation of the site, at the top of dense marine clay, was measured at –47 ft USACE MLT.

At least 30 tropical storms or hurricanes struck Galveston during this period. Aggarwal (2004) modeled the surge for 23 of those storms (see Table 5), including 6 with storm tides estimated in excess of 6.6 ft and 3 in excess of 9.8 ft. Roth (2000) lists an additional 7 storms, including 1919 (8.8-ft surge), 1943, 1947, 1949, Hurricane Cindy in 1963 (4.6-ft surge in Galveston Ship Channel), Tropical Storm Claudette in 1979 (5-ft tides in Chocolate Bayou), and Hurricane Allen in 1980 (5-ft surge). Roth reported a higher, 6-ft tide for Hurricane Audrey and a slightly lower, 7.9-ft tide for Hurricane Debra than estimated by Aggarwal's models. Hurricane Alicia, which was inadvertently omitted from Aggarwal's (2004) table, reportedly produced a 12.1-ft surge at Morgan's Point.

Aside from the steadily increasing depth of the TCC (and the HGNC) during this period, all other relevant navigation projects that exist today were essentially completed by 1917. The jetties and the Texas City Dike had been built. Improvements were made to the dike, replacing the original pile structure with a rubble mound by 1934 and then expanding the latter in 1940 to its present form, but changes in its effect on the current should have been negligible. By 1936 the combined effects of those navigation projects had eroded away the last remnants of the original Pelican Spit. Despite continued dredging in the vicinity and an abundance of severe hurricanes during this period, the rate of erosion at the site was less than at any other time. Yet the overall trend was for increases in the site depth to roughly parallel those of TCC dredging projects.

2005–2009

Multibeam bathymetry recorded for this project in late 2009 showed that no apparent erosion has occurred since the site was discovered in 2005, despite the passage of hurricanes Rita and Ike during that period. The site appears to have stabilized at this depth some time prior to 2005. A number of interesting facts can be deduced from the multibeam data. Figures 21 and 22 show the location of the 2009 artifact recovery grid, discussed in Chapter 6, overlaid on the multibeam bathymetry. Selected large artifacts are labeled on these figures in order to demonstrate their relationships to the scour pattern. The color contour interval of the data is 0.4 ft. The clay layer upon which the site rests, at an elevation of −46.9 ft USACE MLT, is represented by the color gray on figures 21 and 22. The site vicinity is fairly level, and divers were unable to perceive any slope. The highest elevations on Figure 21, located northeast of the site, are only 2.5–2.9 ft above the site's basal clay. The lowest elevations southwest of the site are actually below the site's basal clay. This area of slightly deeper water, at the center of the TCC, is believed due to scour from deep-draft tanker ships.

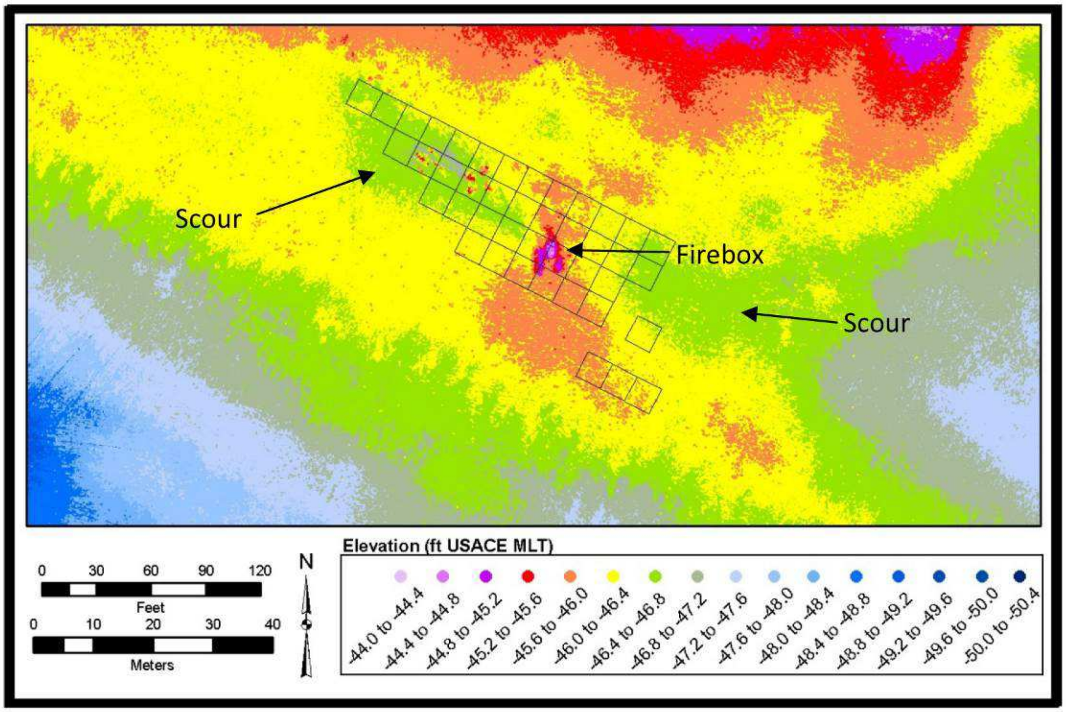


FIGURE 21. MULTIBEAM BATHYMETRY AT USS *WESTFIELD* RECORDED BY C&C TECHNOLOGIES IN NOVEMBER 2009 PRIOR TO ARCHEOLOGICAL FIELDWORK

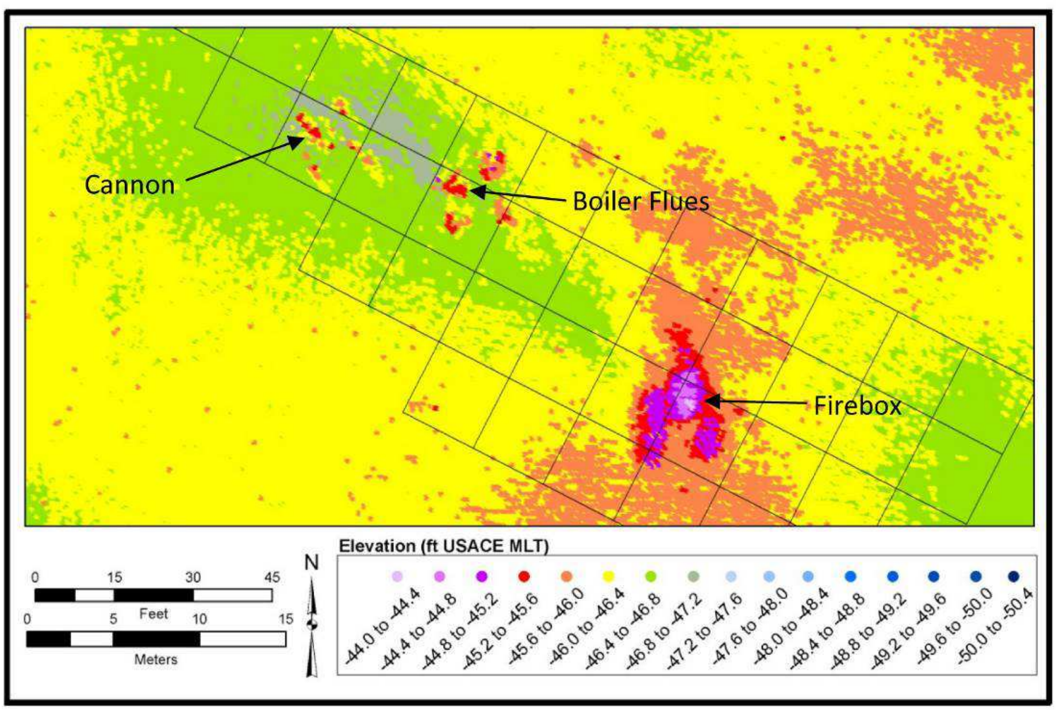


FIGURE 22. CLOSE-UP OF MULTIBEAM BATHYMETRY AT USS *WESTFIELD* RECORDED BY C&C TECHNOLOGIES IN NOVEMBER 2009 PRIOR TO ARCHEOLOGICAL FIELDWORK

The only place on the site with exposed clay is upstream (northwest) of the boiler flues (see Figure 22). It appears that the boiler flues have induced the deepest localized scour on the site. However, the firebox is actually the highest point on the site. It appears that the presence of the firebox and associated materials have contributed to a much broader scour pattern, both upstream and downstream of its position (elongated areas of green on Figure 21), extending across most of the site. The multibeam bathymetry provides a very good estimate of sediment thickness above the clay where the potential for buried artifacts exists. The thickness of sediment above the clay in areas of green (see figures 21 and 22) is 0.1–0.5 ft, yellow 0.5–0.9 ft, orange 0.9–1.3 ft, red 1.3–1.7 ft, and dark purple 1.7–2.1 ft. Sediment in scour holes (indicated by the color green on Figure 21) consists mostly of shell hash resting directly on clay. Site areas above –46.0 ft USACE MLT consist of a matrix of fine sandy mud, containing artifacts and topped by shell hash. With the exception of shell hash, sediments above the clay are believed to be remnants of an inlet-tidal delta soil. Even though artifacts are intermixed with these localized areas of sediment above the clay, particularly in the vicinity of the firebox, that association must be relatively recent, since those artifacts were originally deposited some 40 ft above their modern elevation.

Erosion Summary

Erosion of sediments underlying *Westfield* has clearly been influenced by the depth of TCC dredging. The ebb current parallels the TCC and historically would have cut across the flood-tide-delta sandbar upon which *Westfield* ran aground. Gradual site erosion may have occurred on a daily basis at normal tidal flows; however erosion would have been accentuated during periods of extreme currents. Extreme currents would occur over extended periods, lasting several hours, during storm surge events and, more frequently, during passage of deep-draft ships through the TCC. Delapenna (2009; Appendix B-1) discussed both mechanisms of erosion. In particular, he believes that ship traffic might be a significant cause of site erosion. The rapid displacement of water during passage of deep-draft vessels creates strong currents, which can substantially increase sediment shear stress on the channel bottom and margins. Atkins divers have been present on the site during numerous ship passages along the HGNC, without perceiving significant change in current velocity, thus HGNC ship traffic is ruled out as a major source of site erosion. Ship traffic along the TCC, on the other hand, may have generated periodic strong currents across the site since the channel was widened to 300 ft in 1916. Prior to 1916, however, deep-draft traffic would have passed at least 200 ft south of the site, so the period of most rapid erosion cannot be attributed to ship traffic. The rapid erosion from 1896 to 1917 is believed due to multiple causes, including localized funneling of the ebb tide past the site by upstream dredging of the TCC; completion of the Galveston Jetties; narrowing of the inlet approach cross section by enlargement of Pelican Island; and construction of the Texas City Dike. The effects of those changes would have been accentuated by the three strong hurricanes striking Galveston during that period, although the period was not remarkable for either the number or size of hurricanes.

BIOLOGICAL DEGRADATION OF THE WRECK SITE

Over time, the ship's hull disintegrated due to the interplay of biological, chemical, and physical processes. For example, bacterial action within wood cells causes water-soluble substances such as starch to be leached from the waterlogged wood. This process eventually causes the wood to become more porous and permeable to water, resulting in a significant loss of strength (Hamilton 1998a). The disappearance of *Westfield*'s wooden hull is largely due to the effect of a wood-boring mussel, *Teredo navalis*, which resides in warm, saltwater environments. Any wood features, including a vessel's hull, rigging elements, and artifacts, exposed above the sediment are attacked by these organisms. Vessels that have become buried in sediment have a greater chance of preservation than those that remain exposed in the water column. The anaerobic environment created through burial, especially in dense sediment types such as mud, can protect the vessel's wooden components from the effects of *Teredo navalis*.

The decomposition of wood by *Teredo navalis* also affects the vessel's hull during its active life. The hull of *Westfield* below the waterline was covered by copper sheathing to prevent and retard *Teredo* damage to the ship's timbers. Confederate salvage efforts recovered at least 484 pounds of brass and copper (Appendix B, Letter 18) and "one rudder complete coppered eight feet" (Appendix B, Letter 7). Copper sheathing would offer no protection to the hull once the ship sank, however, as seawater would then cover all wood surfaces, and decomposition would work from the inside of the hull, which was not protected by copper.

The timing of *Westfield's* decomposition is unknown. Lower portions of the hull likely were buried rather quickly by the scour processes described above; however, upper portions of the hull would have deteriorated rapidly. Experience with the use of wooden ships to create artificial reefs shows that their hulls tend to fall apart within about 5 years due to a combination of *Teredo* damage and hurricanes, leaving only the heavier metal components visible (Lukens and Selberg 2004:136). A report of wreck-clearing operations in 1906, 43 years after sinking, stated that most of *Westfield*'s timbers above the seafloor had rotted away (*Galveston Daily News* 1906). The use of dynamite to clear the site for navigation undoubtedly affected the preservation of remaining hull but to what extent is unknown. Trawl fishing might also have removed portions of the site over the years. But the ultimate loss of hull remains may have been caused by erosion of the site down to clay at which point there was insufficient sediment to protect artifacts from either *Teredo* or extreme currents. Atkins archeological divers systematically probed the substrate in 2006 to a depth of 10 ft below the seafloor without striking any buried cultural materials. Wreckage observed by the divers appeared limited in depth of burial to the upper foot of sediment, which consisted mostly of shell hash. Sediment recovery from the site, conducted in 2009, confirmed the complete absence of wooden hull.

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ARCHEOLOGICAL INVESTIGATIONS, 1980–2007

Since 1980, there have been at least 12 published studies relating to archeological investigations in the vicinity of USS *Westfield*. All but one of these studies are associated with proposed USACE projects along the TCC and/or HGNC, and include Hays (1982), Hoyt (1992), Foster et al. (1993), Schmidt et al. (1995), Hoyt et al. (1998, 1999), Gearhart and Schmidt (2002), Jones et al. (2002), Watts et al. (2004), Enright et al. (2005), Gearhart et al. (2007), and Borgens, Hudson et al. (2007) (Figure 23). The majority of these investigations predated the identification of the site remains, and instead involved remote-sensing surveys that either did not record evidence of the shipwreck or were unable to conclusively correlate such evidence to the identity of *Westfield.* In 2005, divers investigated a magnetic anomaly that was long suspected to be a possible location of *Westfield* and, for the first time, documented physical evidence of the gunboat's remains (Gearhart 2005). Since that time, subsequent investigations have primarily focused on further refining the archeological knowledge of the site through intensive remote-sensing surveys, diver investigations, archival research, and artifact recovery.

This chapter presents a discussion of all cultural resource studies from 1980 up to the commencement of artifact recovery operations in 2009. First, a brief synopsis is presented of all projects having a finalized report and/or completed THC antiquities permit. These include every project up to and including a 2002 close-order remote-sensing survey of five magnetic anomalies (Gearhart et al. 2005), which was the first delivery order under the current USACE contract (No. DACW64-03-D-0001, D.O. 0002) relating to the proposed TCCIP. Following those synopses is a detailed presentation of the methods, results, and recommendations for contract D.O.s 0004, 0005, and 0006. These delivery orders include all other projects associated with the TCCIP, beginning with the first diver investigations of the site in 2005 (Gearhart et al. 2007), through the remote-sensing surveys and archival research completed in 2007 (Borgens, Hudson et al. 2007). These projects are presented in more detail in order to complete the reporting requirements for THC antiquities permits 3878 and 4622. Both a draft report of findings (Gearhart et al. 2007) for D.O.s 0004 and 0005 (THC Permit No. 3878), and an interim letter report of D.O. 0006 results (Borgens, Hudson et al. 2007) (Permit No. 4622), were previously submitted for THC review. Each of these draft or interim reports received THC concurrence (see Appendix C), but were never finalized due to USACE requests, in consultation with the THC, to eventually combine the documents into a single report. This report, therefore, serves as the combined final presentation of those delivery orders, as required under antiquities permits 3878 and 4622. The methods and results of the previously unreported investigations conducted under D.O. 0006, Modifications 1, 2, 3, and 4 (Permit No. 5787) are presented in Chapter 6.

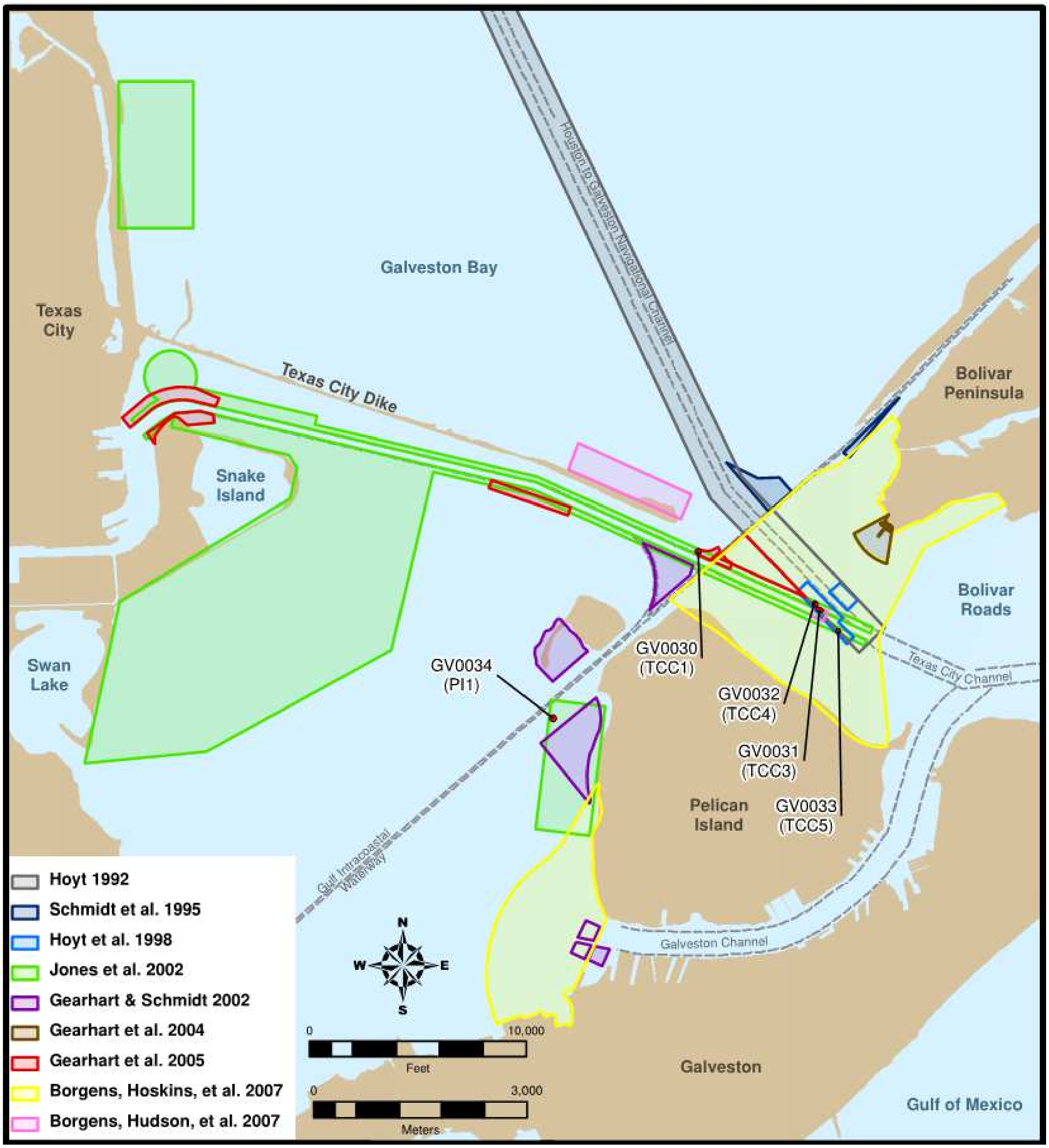

FIGURE 23. PREVIOUS INVESTIGATIONS

PROJECTS COMPLETED 1980–2005

The Archaeology Program of the Institute of Applied Sciences was contracted by the USACE in 1980 (Contract No. DACW64-80-C-0057) to conduct a remote-sensing survey in preparation for proposed modifications to the TCC. Several hundred anomalies were recorded during the survey, though only 12 were recommended for further archeological testing (Hays 1982). In August 1981, a close-order magnetometer and sonar survey was conducted for these 12 anomalies, and as a result, 2 were recommended as potential cultural resources. Although the project area included the current location of *Westfield,* the shipwreck was not detected during this early survey and was not 1 of the 12 anomalies recommended for additional work.

In October and November 1991, Espey, Huston & Associates, Inc. (EH&A, now Atkins) charted 3,400 magnetic anomalies and 570 sonar targets during an archeological remote-sensing survey of the HGNC for the USACE (Hoyt 1992). The survey was performed under Contract DACW64-91-D-0004, D.O. 0002. That project's objectives were to identify significant shipwrecks and other historical resources within Galveston Bay that might be impacted by future USACE undertakings. The project's survey corridor (partially illustrated on Figure 23) measured over 40 miles long and included a linear corridor from the inner end of Bolivar Roads to the Beltway 8 bridge crossing near Houston, as well as a 3.6-mile section of the Galveston Ship Channel. A marine magnetometer was used over the entire survey area, and was augmented with side-scan sonar along the Redfish Bar area, in the corridor above Morgan's Point, and along all of the Galveston Ship Channel survey. The magnetic anomaly of *Westfield* was recorded during the survey, but the then-unidentified target was not selected as 1 of the 18 anomalies recommended for ground-truthing.

EH&A completed extensive archival research for the USACE in 1992 (Foster et al. 1993), as a supplement to the project reported by Hoyt (1992). The work was performed under USACE Contract No. DACW64-91-D-0004, D.O. 0002. Foster et al. defined areas of potential archeological and historical sites within and adjacent to the HGNC. As a result of that research, 103 previously recorded archeological, historical, and shipwreck sites and over 600 other potential historic sites were reported within 1 mile of the HGNC. EH&A compiled that information into a database containing over 500 possible shipwreck sites and made recommendations regarding particular sites and portions of the study area warranting further research. Correlations drawn between the archival research and EH&A's 1991 remote-sensing results (Hoyt 1992) identified five additional locations to be recommended for ground-truthing. Historic accounts also reported several shipwrecks in the vicinity of the TCC survey areas.

In 1994, EH&A conducted a remote-sensing survey and subsequent diver assessment of potential cultural resource remains near the intersection of the Gulf Intracoastal Waterway (GIWW) and HGNC (Schmidt et al. 1995). That project, also conducted on behalf of the USACE (Contract No. DACW64-91-D-0005, D.O. 0004) involved the remote-sensing survey of two areas: a 50-acre (20-hectare [ha]) block located at the GIWW and HGNC intersection, and a 30-acre (10-ha) block between the north side of Bolivar Peninsula and the south side of the GIWW. Magnetic anomalies recorded during the remote-sensing survey were analyzed for their potential as cultural resources. The selection process did not necessarily focus on anomalies having high amplitude or associated side-scan sonar targets. Instead, EH&A's selection objective was to provide a more accurate method of setting priorities for each anomaly according to the suspected historic potential. Representatives from EH&A, the THC, and the USACE decided that diver assessments would be conducted on small, more-complex anomalies that could be indicative of small wooden watercraft. Based on their criteria, 17 anomalies from the two survey areas were selected for diver investigation. Due to time constraints, only 13 of the anomalies were investigated, and all were cleared of any cultural resource restrictions.

Again in 1994, EH&A undertook a separate series of investigations for the USACE to study potential cultural resource localities along the HGNC (Hoyt et al. 1998). The work was conducted under USACE Contract No. DACW64-94-D-0002, D.O. 0004, and consisted of intensive archival research; close-order survey of select areas along the ship channel; radiometric dating of a human mandible fragment discovered on Pelican Island Beach; and investigation of previously identified remote-sensing targets. As part of the study, naval records and historic maps were reviewed as a means to further define the potential location of the *Westfield* wreck site. This research concluded that *Westfield* was located near the intersection of the TCC and HGNC (Hoyt et al. 1998:122). This area was included as part of the close-order survey and was called the USS *Westfield* Survey Tract. It covered an area of approximately 29 acres near the junction of the HGNC and TCC. Three anomalies, TCC 3, TCC 4, and TCC 5, were recorded within the USS *Westfield* Survey Tract, including one at the current location of *Westfield* (TCC 3). This anomaly was later designated GV0031 in a survey conducted by Atkins in 2004. Anomalies TCC4 and TCC5 were renamed GV0032 and GV0033, respectively. Modern water depths were 46 ft at the location of the magnetometer target, exceptionally deeper than at the time of *Westfield*'s wreck event. It was presumed that channel dredging had likely impacted any potential historic sites and therefore there was a low potential to yield intact remains (Hoyt et al. 1998:137). EH&A did not recommend additional dive investigations.

In 1996 and 1997, Atkins conducted a reconnaissance-level archival study for the USACE (Contract No. DACW64-94-D-0002, D.O. 0009), to identify potential historic resources along selected areas of the GIWW between High Island, Texas, and the Brazos River Floodgate (Hoyt et al. 1999). Along the approximately 77-mile section of the GIWW studied, 194 properties were identified, including bridges, private residences, commercial structures, wrecked or abandoned vessels, and other miscellaneous structures. Potentially significant submerged historic resources identified in the Texas City vicinity included several unidentified shipwrecks near the TCC and GIWW intersection.

A remote-sensing survey and visual reconnaissance for historic period sites along portions of the GIWW was performed by Atkins for the USACE in 1999 (Gearhart and Schmidt 2002). The purpose of that work, conducted under Contract No. DACW64-97-D-0004, D.O. 0003, was to inspect submerged and shoreline locations with potential for the presence of historic shipwrecks. Four areas were surveyed for that project, including the Texas City West Wye and Pelican Island Marsh Creation areas. The portion of the survey encompassing the Texas City West Wye, which is a curved channel facilitating the turning of barge traffic between the GIWW and the TCC, produced one magnetic anomaly that was recommended for further investigation. Upon a subsequent close-order survey, however, this target was revealed to be two discrete anomalies, one or both of which were likely associated with a sunken channel buoy. Neither target was recommended for avoidance.

The survey of the Pelican Island Marsh Creation areas produced similar results. Two sonar targets believed to be associated with modern debris were located, as were two adjoining linear alignments of high-amplitude anomalies, which corresponded to a known petroleum pipeline. None of those targets were recommended for further investigation, nor were the survey areas recommended for a subsequent close-order survey. Hoyt et al. (1999:A-4) had and previously identified one potential shipwreck, likely of modern origin, that fell within the boundaries of one of the Pelican Island survey areas. No indication of that wreck, which appeared on National Oceanic and Atmospheric Administration (NOAA) charts in 1976 and 1988, was found as a result of the 1999 survey, leading Gearhart and Schmidt (2002) to conclude that the wreck had likely been removed or misplotted.

As part of the project, Atkins reviewed four contemporaneous maps (1865–1877) to further refine the suspected location of *Westfield*. Analysis of the charts indicated the wreck was located within an area having an 850-ft radius and in close proximity to the juncture of the TCC and Houston Ship Channel (Gearhart and Schmidt 2002:20–21). The study furthermore suggested that one or two of the anomalies recorded in this area in 1994 (Hoyt et al. 1998) were associated with *Westfield.*

Continued remote-sensing investigations of the Galveston area occurred in 2001. Atkins was contracted in late 2000 by the City of Texas City to perform a cultural resources remote-sensing survey and oyster mapping in preparation for the construction of a new Shoal Point Container Terminal (SPCT) (Jones et al. 2002). Plans for construction of the SPCT included dredging of a turning basin and adjacent ship berthing area, deepening of the TCC from 40 ft to 45 ft, and creation of three beneficial use areas: two at Shoal Point and one at Pelican Island. The remote-sensing surveys covered five areas consisting of (1) the Shoal Point Survey, which included the northern flank of Shoal Point where a ship berthing area was proposed; (2) the SPCT Turning Basin Survey; (3) the Pelican Island Survey on the western side of the island; (4) the Dollar Point Survey; and (5) the TCC Survey, which included the shoulders of the channel seaward of the proposed SPCT turning basin. Nine targets were recommended as potentially significant based on their similarity to other anomalies recorded over known shipwreck sites. That number included three anomalies, SP 1, SP 2, and SP 3 (GV0038) in the Shoal Point survey area, Anomaly PI 1 in the Pelican Island survey area, and anomalies TCC 1, TCC 2, TCC 3, TCC 4, and TCC 5 along the TCC. Closely spaced anomalies TCC 3, TCC 4, and TCC 5 were speculated to be the potential remains of *Westfield*. All three targets had also been recorded during the 1994 EH&A survey, and anomaly TCC 3 at that time was thought to be associated with the wreck. Though all nine anomalies were recommended for avoidance, no further archeological examination of TCC 3, TCC 4, or TCC 5 was believed warranted because the water depth suggested they had been previously dredged.

From August to October 2004, under USACE Contract No. DACW64-03-D-0001, D.O. 0002, Atkins conducted a close-order remote-sensing survey in connection with the proposed deepening of the TCC (Gearhart et al. 2005). A portion of the work focused on five anomalies (PI 1, TCC 1, TCC 3, TCC 4, and TCC 5) previously identified in the 2001 Atkins remote-sensing surveys (Jones et al. 2002).

After the close-order survey, anomalies PI 1, TCC 1, and TCC 5 were determined to not have potential historic significance. It was suggested that one or both of the remaining two anomalies, newly designated GV0031 (TCC 3) and/or GV0032 (TCC 4), were likely associated with the wreck of *Westfield*.

In 2007, Atkins was contracted by the Texas Department of Transportation to conduct a marine remote-sensing survey in Galveston Bay, Texas, for the proposed Galveston-Bolivar Causeway (Borgens et al. 2007). Magnetometer, sonar, and bathymetric data were collected within two survey areas, one in Bolivar Roads and the other on the west side of Pelican Island. The Bolivar Roads survey area also encompassed *Westfield*'s location. A total of 47 magnetometer anomalies (M1–M47) were judged to have magnetic signatures similar to those of submerged cultural resource sites. Thirty-nine of these anomalies were in the Bolivar Roads survey area, including USS *Westfield* (M17). An additional close-order survey was conducted on the anomalies designated as potential cultural resource sites. One magnetometer anomaly, M47, corresponds to a feature near the historically charted position of a Civil War–era fort. There were 27 sonar targets; 21 were associated with the magnetometer anomalies (M1–M46) that are suggestive of historic shipwreck sites. Four sonar targets were possibly associated with the submerged historic fort; two sonar targets were shipwrecks at the position of charted wrecks dating to 1936 and 1968; and two targets were sizeable, potentially hazardous obstructions. Atkins recommended avoidance or further investigation by ground-truthing of the magnetometer anomalies and sonar targets.

WESTFIELD INVESTIGATIONS 2005–2007

The following section presents a condensed discussion of the methods, results, and recommendations for fieldwork conducted under D.O.s 0004, 0005, and 0006, of USACE Contract No. DACW64-03-D-0001. Draft technical reports (Enright et al. 2005 [THC Permit No. 3878], Gearhart et al. 2007 [Permit No. 3878]) or interim letter reports (Borgens, Hudson et al. 2007 [Permit No. 4622]) have been previously submitted for each of these delivery orders. Because each of these projects were, in effect, foundational studies for the artifact recovery operations presented in Chapter 6, the USACE has decided, in consultation with the THC, to combine the final reports required for each antiquities permit into this document.

Dive Assessment of Two Anomalies (D.O. 0004)

Following the 2004 close-order remote-sensing survey (D.O. 0002), and as part of D.O. 0004, Atkins conducted ground-truthing of two anomalies in the TCC. The USACE sponsored D.O. 0004 to investigate anomalies GV0031 and GV0032 in preparation for proposed deepening of the TCC from a design elevation of –40 ft USACE MLT to –45 ft USACE MLT. The proposed deepening project would initially include 3 ft of advanced maintenance dredging and 2 ft of allowable overdepth dredging, making the bottom elevation of new dredging –50 ft USACE MLT. The TCC is naturally deeper than its present design depth at these locations; thus, these two anomalies and the adjacent channel bottom had never been dredged, contrary to what had been previously believed by archeologists. The main purpose of D.O. 0004 was to determine whether *Westfield* wreckage was the source of either anomaly, and if so, to provide a preliminary assessment of NRHP eligibility.

Field Methods

Diving Investigation

In August 2005, Atkins conducted a diving investigation of anomalies GV0031 and GV0032. Diving was performed using standard surface-supplied air equipment including a high-pressure cascade-style air delivery system, regulated to breathing pressure through an AMRON International, model 8225-HP Diver Control System, which also provided diver to surface communications. Additional equipment included a Schonstedt GAU-30 marine gradiometer to guide divers to individual magnetic sources on anomalies GV0031 and GV0032. A gradiometer is a differential magnetometer utilizing two sensors separated by a fixed distance. The directional sensitivity and adjustable scale of this gradiometer allows one to search for individual anomaly sources within a larger composite anomaly of multiple sources, such as is the case with a shipwreck site. Readings were monitored topside and relayed through wireless communications to the diver. The topside unit displayed the magnetic gradient on a visual scale and output an audio tone. Based upon voice-communicated readings, the diver could alter a search and home in on anomaly sources. Anomaly investigations were aided, where necessary, by hydraulic jetting of bottom sediments.

Remote-Sensing Surveys

Two remote-sensing surveys were conducted in conjunction with diving operations on this project. A close-order magnetometer survey was conducted over GV0032 on August 28, 2005, and a side-scan sonar survey was conducted over GV0031 on September 2, 2005. Both surveys were carried out aboard *Pee Wee McKinney*, a shallow-draft, 20-ft aluminum boat. Close-order survey was defined in this case as adhering to a maximum transect spacing of 33 ft. Equipment included an EG&G Geometrics G-882 cesium magnetometer, a CODA Technologies DA75 side-scan sonar data acquisition system, an Edgetech DF1000 500-kilohertz (kHz) sonar towfish, and a Trimble Ag132 differentially corrected Global Positioning System (DGPS). Trimble's HYDROpro® software (version 2.0) was used for both navigation guidance and data logging. HYDROpro calculated and recorded position estimates for the magnetometer and sonar sensors in real time. The magnetometer sensor was towed below the surface 46 ft aft of and in line with the DGPS antenna. The side-scan sonar was towed 10 ft above the seabed, 89.3 ft aft of and in line with the DGPS antenna. The side-scan sonar was set to image the bottom for a distance of 82 ft on either side of the survey track.

The raw magnetometer data were exported from the navigation software as a text file and imported into a Microsoft EXCEL® spreadsheet containing a mathematical filter that removes diurnal fluctuations. Any total-field value differing by greater than 0.5 gamma from the average of either the preceding three or following three recorded values was considered part of an anomaly. The difference between anomalous values and the ambient magnetic field was then substituted for the actual total-field value recorded by the magnetometer. Magnetic values not meeting this criterion were considered part of the magnetic background or ambient level. The difference between two adjacent readings (a number very close to zero) was substituted for the magnetic total-field reading in such cases. This algorithm results in a data set in which abnormally high and low magnetic values (anomalies) center around a zero background level. The resulting data set represents the magnetic total-field amplitude relative to the ambient magnetic field. One result of the above process is that relatively long-term trends in the magnetic data amplitude, such as those caused by diurnal variation, geologic gradients, or gradual changes in water depth, are filtered out of the data set, leaving only local magnetic anomalies. A side benefit of this process is that visual representations of the data can easily reflect the dipolar nature of the magnetic anomalies.

A magnetic contour map was prepared following the application of the filter to remove low frequency diurnal variations. Bentley's GEOPAK® digital terrain-modeling software was used to contour the data. A regularly spaced data grid or lattice was created from a triangulated model of irregularly spaced data using GEOPAK by linear interpolation of values at each grid intersection based upon the values of the nearest triangle sides. A grid interval of 6.6 x 6.6 ft was chosen, as this is near to the minimum travel distance between successive magnetometer readings. The data set was contoured using a 5-gamma interval.

Factors Affecting Dive Operations

Several environmental factors affected the productivity of dive operations, including the timing and strength of tidal currents, weather, and the positions of GV0031 and GV0032 relative to the TCC. The tidal curve from an automated tide gauge at Pier 21 in Galveston is illustrated on Figure 24 for the period of this project. The duration of each dive is overlaid as a red line on the tidal curve. During the project there was only one tidal cycle per day, with high tide occurring during early daylight hours on August 27 and moving about 1 hour later each day thereafter. During daylight hours of most days, the tide was ebbing by the time the dive boat was anchored in a suitable position to allow tethered divers to reach the site. As the ebb flow increased, productive diving eventually became impossible. The daily increase in ebb flow, illustrated as points of inflection in the tidal curve on Figure 24, became noticeably steeper following completion of each day's diving. This marked the time of each day at which the current became unworkable for divers.

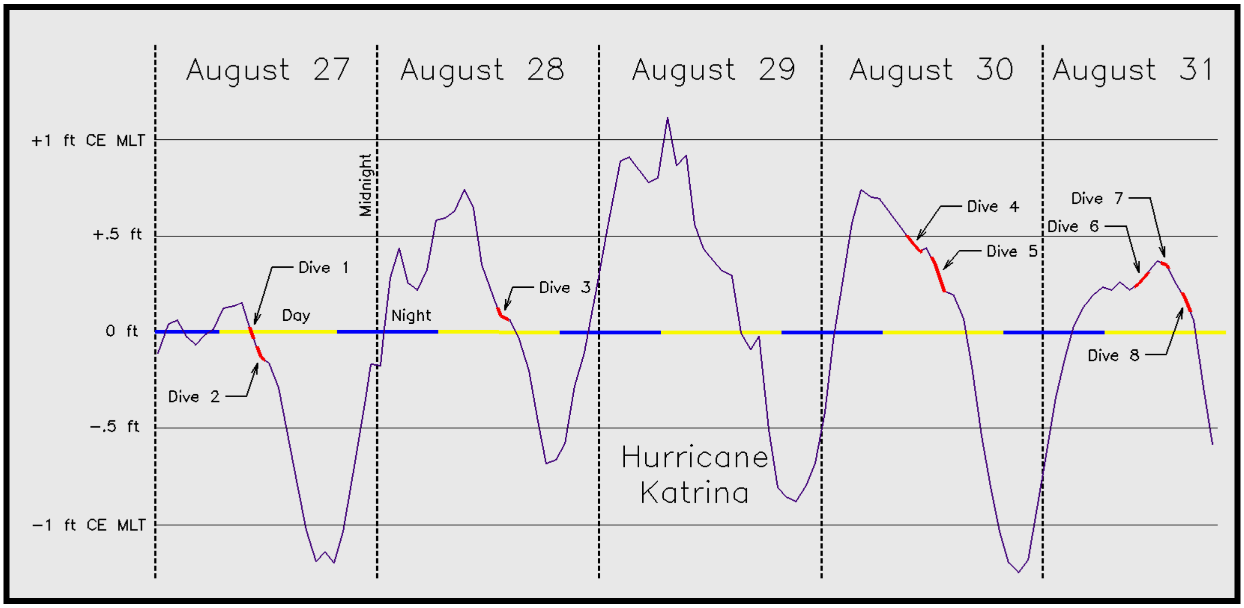

FIGURE 24. TIDES FOR PIER 21, GALVESTON

On August 29, work was not possible due to strong northerly winds associated with the counterclockwise circulation around Hurricane Katrina as it moved onshore along the central Gulf Coast. The tide was higher than normal from August 28 to 30 as a result of that storm. The northern winds on August 29 and 30 pushed the high tide back to earlier in the day, resulting in the ebb tide lasting throughout daylight hours on both of those days.

The proximity of Anomaly GV0032 and *Westfield* to the TCC (Figure 25) necessitated bringing divers to the surface when ships passed. The large displacement of water by ships creates a hazardous current as they pass and can potentially impact the anchorage of the dive vessel. The diver ascent began at least 10 minutes prior to the arrival of each ship in order to allow a margin of safety. Passage of ships on the HGNC did not create a noticeable current; however, the diver was recalled from the water whenever the captain of an approaching vessel on the HGNC made this request.

Daily anchoring of the dive boat was a time-consuming task complicated by proximity of the dive locations to the TCC combined with changes in wind and current directions. A three-point anchorage system was necessary to hold the stern of the dive boat close enough to the desired dive target so that the diver's umbilical would reach. Unfortunately it was not always possible to place anchors at optimal positions to allow for shifts in wind and current directions. The dive boat could not be anchored within the TCC nor could anchors be placed within the channel. This limited the spread of the three-point anchor array to 180 degrees of a circle located northeast of the TCC and made holding a position close to the channel problematic when faced with a southerly wind, especially if the tide was slack.

FIGURE 25. PROXIMITY OF DIVE ANCHORAGE TO SHIP TRAFFIC

Results

Anomaly GV0032

Anomaly GV0032 was investigated first because, based on its characteristics, it was the less likely of the two anomalies to be associated with *Westfield* (Enright et al. 2005). Furthermore, fewer troubles were anticipated in identifying its source, and it provided a more accessible environment for troubleshooting the first dive of the project. It was situated at a higher elevation than GV0031, so if a fluff layer was present in the nearby TCC, it might not extend far up the slope, allowing divers better visibility. Atkins investigated Anomaly GV0032 on August 27, 2005. Two dives were conducted at a minimum depth of −40 ft USACE MLT and lasted a combined 69 minutes. Water visibility averaged 2–3 ft at the bottom. The bottom consisted of a flat stratum of oyster shell hash and coarse sand mixture. Investigative goals for both dives included a gradiometer search accompanied with manual subsurface testing utilizing a 3-ft-long probe. Manual probing revealed that the top layer was approximately 6 inches thick with firm clayey sediment lying beneath. On both dives, gradiometer readings guided the diver to several small concreted iron objects. On Dive 2 approximately 40 small unidentifiable amorphic concretions were discovered, and a random selection was recovered and brought topside for further investigation. They were photographed and returned to the site. Subsurface probing at the location of these objects returned negative results. At the conclusion of the day's diving operations, a length of 1–1½-inch braided steel cable was snagged by the starboard stern anchor. Its weight prohibited lifting it on board, so it was dragged away from the dive vessel (Figure 26) and disposed of outside of navigation channels. Examination of the boat location at the time of the dives and during the anchoring process suggested that the cable might be the source of Anomaly GV0032. A subsequent magnetometer survey was conducted over the area, which returned negative results (Figure 27) and proved that this length of modern cable was the source of Anomaly GV0032. The miscellaneous ferrous concretions were not substantial enough to create a magnetic anomaly.

Anomaly GV0031 – USS Westfield (41GV151)

Atkins investigated Anomaly GV0031 on August 28, 30, and 31, 2005. Six dives were conducted at a minimum depth of –46 ft USACE MLT and lasted a combined 424 minutes. Dive investigations were not conducted on August 29 due to strong winds associated with the periphery of Hurricane Katrina. Most dives were conducted under slack tidal conditions and therefore encountered no significant current.

Water visibility at the bottom varied and ranged from near zero to approximately 4 ft. The bottom was level and consisted of a mixture of shell hash and coarse sand. Manual probing with a 3-ft probe revealed that this layer was approximately 6–9 inches thick with firm claylike sediment lying beneath. At the onset of the site investigation, the search efforts were guided by gradiometer due to the presumption the wreck was buried. The final day of diving, however, was focused on locating and identifying exposed wreckage over as wide an area as possible in the time remaining. In conjunction with that effort, manual probes were attempted intermittently but with limited success due to the layer of compacted sediment just beneath the seabed. No solid object was contacted within the 9-inch-thick layer of shell hash and coarse sand.

Each exposed piece of wreckage that a diver encountered was examined for diagnostic features and to determine whether it was isolated or attached to underlying materials. Artifacts located and investigated during the dive investigations at GV0031 included up to six round cannon shot or shell, some of which were approximately 10–12 inches in diameter; three possible cylindrical projectiles; a semispherical iron object within a three-sided wood box; sections of iron pipe; four cupreous spikes; and several pieces of plate iron. Several larger objects were encountered that included a large cannon and boiler flues, the latter measuring approximately 10 x 2 ft in size. Divers also identified an isolated length of iron pipe approximately 6 ft long and approximately 2 inches diameter, flush-mounted to a metal plate approximately 1½ inches thick and 6 inches square. The plate had the possible remains of fastener heads on two raised portions on diagonally opposite

FIGURE 26. DRAGGING CABLE ANOMALY SOURCE AWAY FROM GV0032

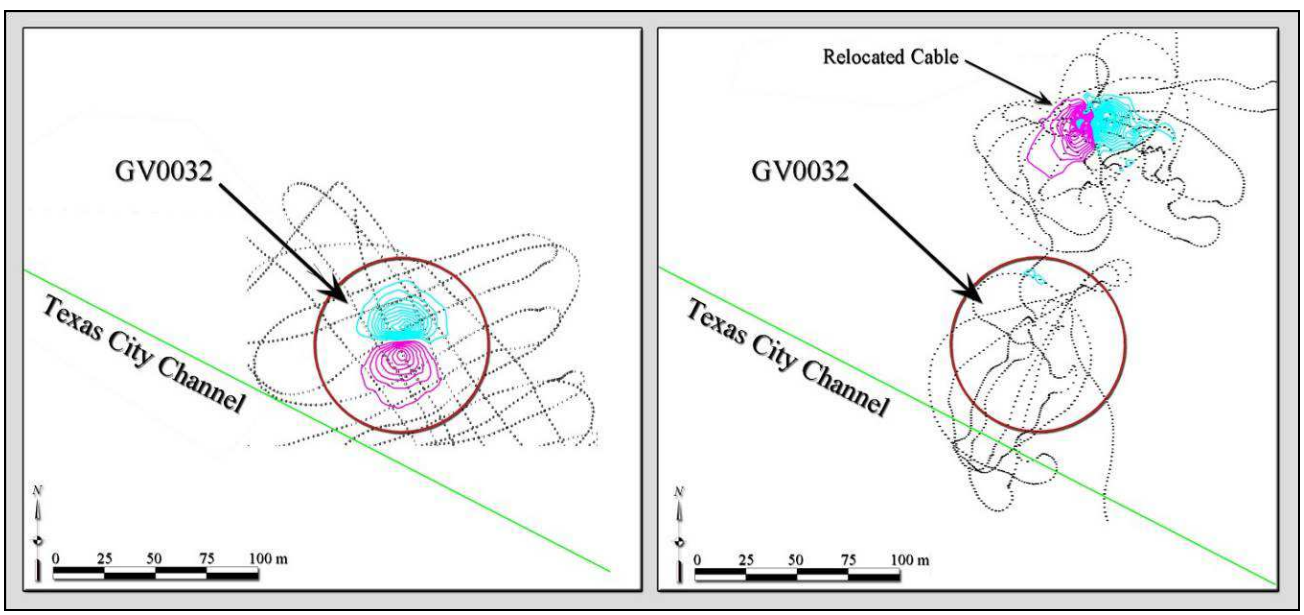

FIGURE 27. GV0032 ANOMALY BEFORE AND AFTER CABLE REPOSITION

corners. Modern intrusive debris located at GV0031 included glass bottles, shrimp netting, rope, clothing, and an electrical junction box containing two rubber-insulated wires. Artifacts recorded during this dive and later recovered in 2009 are discussed in greater detail in Chapter 6.

Many components of the site were not resolved during the diving investigation, including the amount of buried material and its level of exposure. The size of the vessel was approximately 213 by 34 ft, indicating the likelihood of an even larger wreck site caused by the dispersal of exploded shipboard materials. A thorough search for buried artifacts was not feasible under the scope of D.O. 0004. Determining the level of wreck exposure, however, was accomplished by conducting another side-scan sonar survey of the site following completion of the dive schedule.

The higher resolution images generated by the survey contributed significantly to our knowledge of the wreck site. The CODA sonar acquisition software integrated geographic positions with the sonar graphics image, which was stored automatically to electronic media. A geo-referenced mosaic was created from the original stream of side-scan sonar data. A separate geotiff image was created from the mosaic for each survey track that crossed over the top of the wreck. Each survey track geotiff has a resolution of 15 pixels per meter. The best views were selected for each area of the debris field from all the available geo-referenced survey tracks. The selected portions of each survey track then were combined into a single composite image using translucent overlays in Adobe PhotoShop®. The result is a composite sonar map of the debris field of a much higher quality than could have been obtained using the mosaic software alone (Figure 28). Once the composite image was completed, its position, already geo-referenced within the mosaic software, was geographically refined in Bentley Systems, Inc., MicroStation© CAD software (version 8) by centering the cannon image on a high-confidence DGPS position obtained over a plumbed buoy line attached to the cannon by a diver. This step allowed what we believe to be an accurate overlay between the composite sonar image and USACE project plans showing the design limits and channel stationing of the TCC. As an aid to visualizing overlays on the sonar map, a detailed black-on-white tracing was inked and stippled from the composite imagery.

A composite sonar image of the main debris field is illustrated on Figure 28. The main concentration of exposed wreckage measures 164 x 82 ft. Visible within the main debris field on the sonar were one cannon, boiler flues, and numerous objects that were as yet unidentified. Beyond the area illustrated on Figure 28, at least 20 isolated pieces of debris were recorded by the sonar scattered over a 300-ft radius centered roughly on the wreck. Included in the latter items was a cluster of large objects measuring 11 by 29 ft located 230 ft west of the cannon.

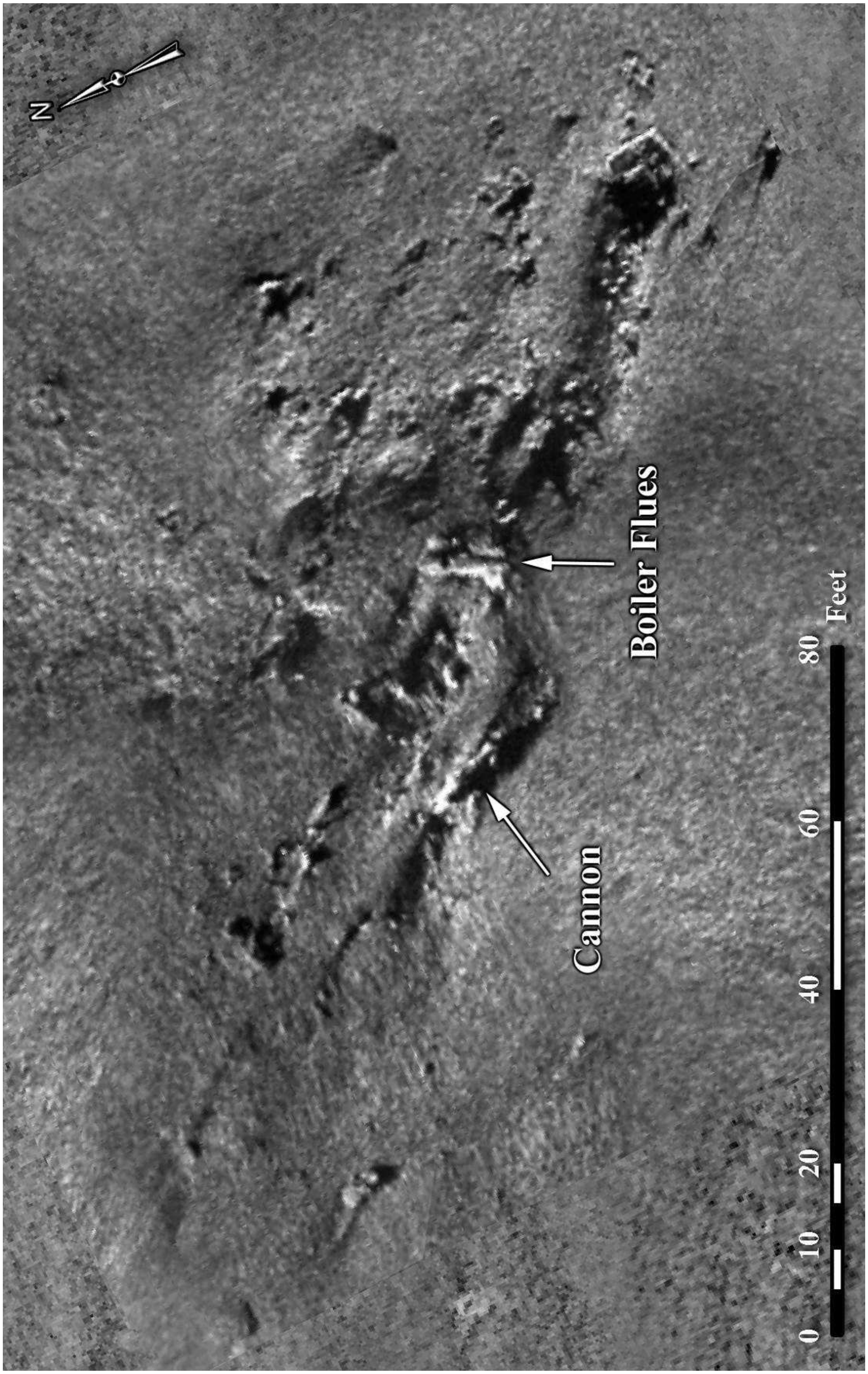

FIGURE 28. COMPOSITE SONAR IMAGE OF SITE 41GV151 (REVISED FIGURE BY BORGENS AND LAURENCE 2010)

Summary and Conclusions

Delivery Order 0004 was designed to determine, through archeological diving assessments, whether either of two magnetic anomalies (GV0031 or GV0032) was associated with the wreck of *Westfield*, and if so, to ascertain whether the wreck retained sufficient integrity to be potentially eligible for listing in the NRHP. The goal of the assessment was to locate the source(s) of each anomaly, identify those sources, gather sufficient information for an initial assessment of NRHP significance, and make recommendations for further field assessments as necessary.

Anomaly GV0031 was identified as a shipwreck corresponding to *Westfield* in age and location and was assigned archeological site number 41GV151. Atkins recommended this wreck as potentially eligible for listing in the NRHP (Gearhart et al. 2007). Anomaly GV0032 was caused by a modern steel cable and has no historical significance. Side-scan sonar mapping and diver investigations of 41GV151 determined that an extensive debris field was exposed over an area of about 6,200 ft^2. Exposed wreckage included one cannon, numerous cannon projectiles, portions of a suspected gun carriage (later disproved), remains of boiler flues, four bronze spikes, several sheets of plate iron, and multiple unidentified iron components and concretions. Proposed new dredging for the TCCIP would affect approximately 80 percent of the visible wreckage within the main concentration of material.

Buried materials were encountered by divers only in the upper 1 ft of sediment. Manual probing was limited to the upper 3 ft of sediment. Atkins recommended archeological testing sufficient to definitively substantiate or refute the NRHP eligibility of 41GV151. That effort, reported below and in Chapter 6, included extensive subsurface probing as well as detailed mapping, inspection, and documentation of exposed surface features. In the event substantial buried remains were encountered by future work, then excavation of test trenches was recommended sufficient to characterize the extent and condition of those remains, as well as to document the types of materials and range of construction details that typified any such remains.

Probing was recommended along multiple transects crossing the long-axis of the debris field at right angles. The goal of probing was to determine and map the extent of buried remains. Penetration to a depth of 10 ft or to a depth of solid refusal was desirable if conditions allowed. Each probe location was to be mapped and characterized as to depth and type of material contacted. Mapping of exposed wreckage was recommended to include low-light video documentation and/or still photography when conditions allowed.

NRHP Assessment of Site 41GV151 (D.O. 0005)

Physical evidence resulting from the completion of D.O. 0004, combined with historic cartographic evidence presented in Gearhart et al. (2005), suggested that 41GV151 was the wreck site of *Westfield*. The primary objective of D.O. 0005, conducted in June 2006, was an intensive investigation to conclude whether the site was eligible for listing in the NRHP. Two secondary objectives guided the gathering of information to support the NRHP assessment. Those objectives included (1) acquiring further evidence to substantiate the identity of the vessel wrecked at 41GV151, and (2) mapping the horizontal and vertical extent of wreckage.

At the conclusion of work on D.O. 0004, the identity of 41GV151 appeared likely to be *Westfield*; however, it would have been problematic to pursue any course of action regarding this site only to find out later that it had been misidentified. Therefore, one objective of D.O. 0005 was to gather additional evidence to substantiate the identity of 41GV151. Some of the resulting evidence was circumstantial and was based on comparisons between physical remains and historic documents. Other evidence discovered under D.O. 0005 was more direct, including manufacture dates stamped on two artifacts. Because the wreck was conclusively identified as *Westfield* following the field results of D.O. 0005, the site is referred to interchangeably throughout the remainder of this report as either 41GV151 or as *Westfield*.

Methods

Mapping the horizontal extent of wreckage at 41GV151 included efforts to accurately determine the geographic positions of objects through both diving and remote sensing, and, to the extent possible, graphically document individual artifacts and determine their function. Dive operations were conducted in nearly the same manner for D.O. 0005 as for D.O. 0004, using surface-supplied air (Figure 29a). No crew changes were made; however, a few equipment additions resulted in significant improvements in efficiency over the previous field session. These included the use of an acoustic positioning system to track and record the underwater progress of divers in real time. A LinkQuest Ultra-Short-Baseline (USBL) system was used for this purpose. The USBL system consisted of an acoustic transceiver on the dive boat (Figure 29b) and a roving transponder carried by a diver (Figure 29c). The transceiver was mounted at a fixed location over the side of the dive boat such that it had an unobstructed line-of-sight to areas of interest on the seabed. The transceiver head was divided into virtual sectors that can detect the direction of arrival (relative bearing) for packets of acoustic information arriving from the transponder. The transceiver was mounted on the boat so that its zero-degree mark was pointed toward the bow. A DGPS was used to position the transceiver in a geographic coordinate system. A motion sensor mounted to the transceiver pole removed the effects of heave, pitch, and roll from the transceiver position. A gyroscopic compass was used to determine the heading of the dive boat, so the relative bearing of a diver's transponder could be converted to a compass bearing. Measurements by all of these sensors were simultaneously fed into HydroPro (v. 2) navigation software, which performed the calculations to determine the diver position in real time.

Another significant improvement over the 2005 field session was the addition of audio and video recording capabilities. Beginning with Dive 7 (of 26), diver video and audio were recorded. A low-light camera was fastened to the top of the primary dive mask (Figure 29d). The video feed was displayed on a deck monitor while it was recorded, so persons keeping dive notes on the boat could

FIGURE 29. DIVE AND POSITIONING OF EQUIPMENT USED FOR D.O. 0005

see what was being recorded. This greatly improved everyone's level of understanding about the information each diver was trying to convey, and it allowed diver's to recognize features on the bottom prior to ever having seen them in person. This in turn improved the efficiency of each dive, as time was not wasted needlessly covering the same ground.

A total of 26 dives were completed on *Westfield* during the first half of June 2006. Bottom time totaled 35 hours and 53 minutes (Table 7). All but the first six dives were recorded on audio and video tapes totaling about 28 hours of video tape. Divers investigated large objects and artifact concentrations, resulting in much of the main debris field being revisited. Additional remote-sensing efforts also aided in mapping the extent of wreckage. These efforts included the use of a CHIRP sub-bottom profiler to map the horizontal and vertical extents of acoustic anomalies buried in the sediment; sector-scanning sonar in combination with USBL to improve upon the geo-referenced positioning of exposed wreckage; and additional side-scan sonar survey in an attempt to improve the resolution and geographic accuracy of available imagery. A secondary result of the side-scan sonar survey was the discovery and mapping of several additional sonar targets in undredged portions of the TCC that might represent scattered portions of the site. The CHIRP sub-bottom profiler and side-scan sonar surveys were conducted simultaneously in 2006 as out-of-scope items at no additional expense to the USACE.

TABLE 7. D.O. 0005 DIVE TIMES

Date	No.	Diver	Dive Times	Bottom Time (min.)	Date	No.	Diver	Dive Times	Bottom Time (min.)
6/1/2006	1	Jenna Enright	16:53; 17:33	40	6/8/2006	14	Doug Jones	2:06; 3:43	97
6/2/2006	2	Doug Jones	15:50;17:23	93	6/9/2006	15	Jeff Enright	9:50; 11:37	107
6/3/2006	3	Jeff Enright	16:20; 17:54	94	6/9/2006	16	Sara Hoskins	12:19; 13:21	62
6/3/2006	4	Sara Hoskins	18:15;19:18	63	6/9/2006	17	Bob Gearhart	13:54; 14:54	60
6/4/2006	5	Bob Gearhart	15:57; 17:29	93	6/10/2006	18	Amy Borgens	10:46; 12:27	101
6/4/2006	6	Amy Borgens	18:10;19:22	74	6/10/2006	19	Jenna Enright	13:09; 14:45	97
6/5/2006	7	Jenna Enright	15:34;17:13	99	6/10/2006	20	Doug Jones	15:23; 16:59	96
6/5/2006	8	Doug Jones	17:35;18:29	54	6/11/2006	21	Jeff Enright	11:42; 12:28	46
6/6/2006	9	Jeff Enright	12:05;13:43	98	6/11/2006	22	Sara Hoskins	13:15; 14:51	96
6/6/2006	10	Sara Hoskins	15:34; 17:10	96	6/11/2006	23	Bob Gearhart	15:11; 16:46	95
6/7/2006	11	Bob Gearhart	14:31;15:51	90	6/12/2006	24	Amy Borgens	12:30; 14:05	95
6/7/2006	12	Amy Borgens	16:26;17:32	66	6/12/2006	25	Jenna Enright	14:30; 16:05	95
6/8/2006	13	Jenna Enright	11:31; 13:08	97	6/12/2006	26	Doug Jones	16:46; 17:35	49

A side-scan sonar survey was conducted using an Edgetech DF1000 towfish, towed approximately 16 ft above the seabed. The raw sonar data were recorded by the CODA *GeoSurvey* acquisition system directly to DVD disks. The navigation software calculated and recorded position estimates for the sonar towfish in real-time and relayed those positions to the sonar acquisition computer for integration into the digital sonar record. Upon completion of the sonar data acquisition, a mosaic image was created, which was converted to geotiff format with a resolution of 10 pixels per meter and imported into Microstation CAD software.

A sector-scan sonar was deployed during the June 2006 dive operations. The sonar model used was an MS1000 manufactured by Kongsberg Simrad Mesotech Ltd. The transducer operated at an acoustic frequency of 675 kHz and rotated mechanically at intervals of 0.225 degree. It had a horizontal beam width of 0.9 degree and a vertical beam width of 30 degrees. The transducer head was deployed at an approximate height of 7–8 ft above the seabed using an aluminum tripod with adjustable legs. A USBL transponder was mounted in the center of the tripod to record its position. A series of sonar images, displayed on the computer screen in a radial pattern resembling radar, were captured and stored as bitmaps. These images were imported into Microstation CAD software using their center positions recorded from the USBL transponder. Overlapping images were then rotated to their correct orientation by matching common features.

A sub-bottom profiler geophysical survey was conducted using an Edgetech SB-424 CHIRP towfish operating with a bandwidth of 4–24 kHz and a pulse repetition rate of 250 milliseconds (mS). The 2,000-watt amplifier was operated at 5 percent power. Published specifications for the SB-424 towfish claim 1.6-inch vertical resolution for this system, as configured, and a beam width of 16 degrees. The raw CHIRP data were recorded by the CODA *GeoSurvey* acquisition system directly to DVD disks. The navigation software calculated and recorded position estimates for the SB-424 towfish in real-time and relayed those positions to the sub-bottom acquisition computer for integration into the digital seismic record. The SB-424 was towed 3.6 ft to port and 3.9 ft forward of the GPS antenna.

Determining the vertical extent of buried wreckage was accomplished through a combination of divers probing the seafloor and interpretation of CHIRP sub-bottom profiles. Various systems of probing were tried in an attempt to reduce the level of physical effort without diminishing the effectiveness of the probe on penetrating the seabed. Initial efforts used 150 psi air from a spare bank of T-bottles supplied to the diver through a 5/8-inch hose and probing with a section of ¼-inch iron pipe. Divers also tried a pneumatic drill with a 4-ft-x-1-inch auger bit and a 5-ft-x-3/8-inch steel rod with a sliding hammer. All three of these methods worked well in silt and shell hash; however, none of them was any match for layers of dense estuarine clay. The only effective, but most labor intensive, method of penetrating clay proved to be using a 5-horsepower trash pump to deliver water to the diver through a 2-inch-diameter hose with a ¾-inch iron pipe used as the probe. Hydraulic probe lengths were either 6 or 10 ft.

Documenting the physical and historic integrity of the site was an analytical task, much like making a case for identification of the site. Evidence of physical integrity was observed through all aspects of fieldwork. Discussion of historic integrity has relied on a combination of primary and secondary sources. These two lines of evidence, one physical and the other documentary, are discussed separately below as they relate to the NRHP assessment.

Results

Work conducted by Atkins in 2006 as part of D.O. 0005 conclusively demonstrated that 41GV151 is the wreck of USS *Westfield*. Divers identified multiple, variably sized diagnostic artifacts representative of steamboat machinery and militaria. Through diver examination, probing, and remote-sensing, archeologists mapped the horizontal and vertical extent of the wreck site and have concluded it is a largely disarticulated artifact debris field without evidence of extant hull. Atkins also examined the site for eligibility to the NRHP. The NRHP evaluation resulting from this effort is presented in Chapter 8 and has been updated to incorporate additional insights derived from the recovery and conservation of artifacts.

Identification of 41GV151

In conjunction with the NRHP evaluation of 41GV151, an important objective of D.O. 0005 was to gather additional evidence to substantiate its identity. Three key components of research and examination were utilized to solidify identification of site 41GV151 as *Westfield*. Cartographic evidence presented by Atkins in 2005 (Gearhart et al. 2005) firmly established the location of the wreckage in the vicinity of 41GV151. This research has been summarized in the following section. An investigation of the military engagement at Galveston on January 1, 1863, also demonstrated that there are no other Civil War–era wrecks from this event at the location of the site (see Table 5). And lastly, diagnostic artifacts examined by Atkins archeologists in 2006, conclusively demonstrate 41GV151 is the wreck of *Westfield*. The artifacts examined in 2006 are introduced in this section but are discussed in detail in Chapter 7.

Cartographic Evidence for the Identity of 41GV151: Earlier efforts to geographically reference Galveston Bay historic charts to the modern landscape were fraught with difficulties and uncertainties due to a lack of permanent landmarks. Such efforts relied on overlaying positions of one landmark common to two maps, rotating one sheet to match north arrows, and then scaling the historic drawing until a "best fit" compromise was achieved. At best, two common landmarks might be present, thus allowing one to both scale and rotate the historic map against the modern map. In the absence of any matching landmarks, a comparison of shoreline configurations was the next choice. The last resort usually was trying to compare geographic lines of latitude and longitude. Invariably if landmarks or shorelines appeared to line up, north arrows were oriented differently, and geographic grids never agreed with one another. One usually settled for a wide range of uncertainty. Results have varied considerably from one investigator to the next, even when relying on the same few primary source maps (Gearhart et al. 2005).

Unlike those earlier efforts, geographic overlays used for D.O. 0005 were prepared by converting the historic geodetic coordinate grid of each map to a modern world geodetic grid system. This method is based on a thorough knowledge and understanding of cartography and geodesy. Any significant inaccuracies in the results should be limited primarily to those errors of position inherent in each of the original historic charts, which are surprisingly accurate.

Six historic charts were digitally geo-referenced by Atkins in 2004 when the location of *Westfield* was still unknown. No sonar target had been discovered at that time, and the site was only known as a magnetic anomaly with the designation GV0031. The geo-referencing methodology is documented in Gearhart et al. (2005). One of these charts (Stanton 1868) was discounted because of obvious inaccuracies. The geo-referenced positions for the five remaining charted positions of *Westfield* relative to the TCC are summarized on Figure 30. Five of the six position estimates resulting from Gearhart et al. (2005), again excluding Stanton (1868), cluster within 449 m of one another. Three positions cluster within 133 m of one another. The average of the three most closely grouped positions falls directly on top of *Westfield*. The average of all five positions falls 130 m west of the three-position average.

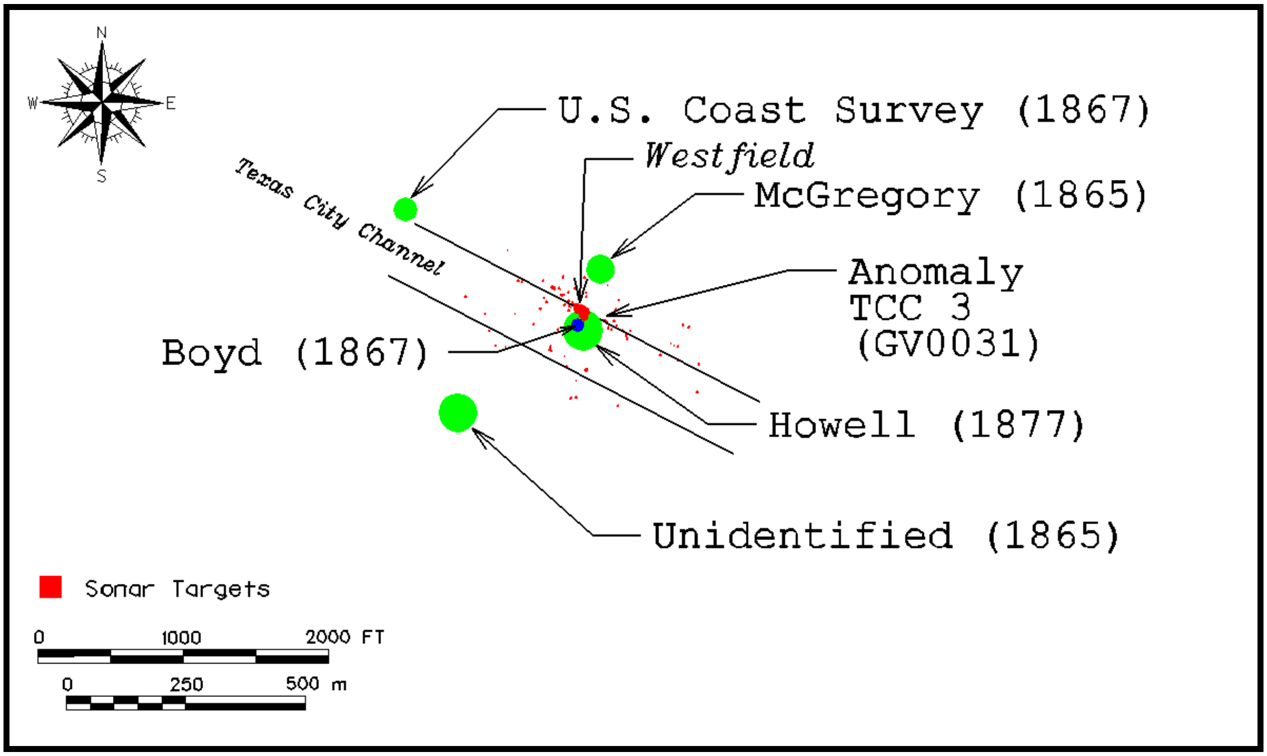

FIGURE 30. COMBINED POSITION ESTIMATES FOR USS *WESTFIELD*

The cartographic results provide a strong argument to support the identification of 41GV151 as *Westfield.* They also indicate a clear consensus among map makers that *Westfield* grounded on the north side of a shoal. Historic accounts of the battle indicate it must have been steaming in a westerly direction at the time, since it was trying to intercept Confederate steamers approaching Galveston from farther up the bay. These results also demonstrate this methodology's potential for a remarkable level of geographic accuracy, especially when multiple source maps are available to allow removal of random errors through averaging of positions.

Diagnostic Artifacts from 41GV151: Atkins divers observed and recorded a variety of artifacts during the 2006 NRHP dive assessment. Several different categories of artifacts were extant on the seafloor and included munitions, portions of machinery, and remnants of the hull in the form of fasteners and protective iron plating. Three artifacts, however, firmly established site 41GV151 as the wreck of *Westfield*: the cannon and two dated shell fuses. Artifacts recorded during the NRHP assessment are only cursorily discussed in this chapter; a more thorough discussion of the artifact assemblage is included as Chapter 6.

The gun found at the site was distinctly bottle-shaped, with a slight muzzle flare (Figure 31). Recorded measurements, in combination with its shape, suggested the cannon was a 9-inch Dahlgren. This identification was confirmed in 2009, after it was recovered from the site. The cascabel has a horizontal hole for the breeching tackle and is pierced vertically by the remains of the elevating screw. A rimbase is present at the base of each trunnion, providing additional strength at this juncture with the main body of the cannon, and preventing the gun from shifting within its carriage (Gibbon 1860:62). No vent or sight was observed, indicating the likelihood that the gun was overturned, as was the case with at least one of the salvaged guns (*Houston Tri-Weekly Telegraph* 1863a). Divers also located a series of linear objects adjacent to the cannon. It was originally suggested that these objects could be associated with the gun's carriage; however, work conducted in 2009 did not locate such an artifact.

Diver exploration of the wreck site located several examples of concreted round shot of varying diameters measuring approximately 8–8.5 inches, 10 inches, and 11 inches, a single shot measuring approximately 14 inches in diameter, and a concreted collection of small-circumference round shot indicative of grapeshot (the thickness of the concretion measured on some partially exposed artifacts ranged from ¼ to 7/8 inch). These shot were likely ammunition for the 8-inch smoothbore cannon, the 9-inch Dahlgren, and a shell for a 13-inch mortar gun. At least one 8-inch shell was fused. This illustrated the possibility that some live shells with intact powder and fuse mechanisms might exist at this site. Unexploded ordnance (UXO) is hazardous to dredging operations and must be removed by qualified Explosive Ordnance Disposal (EOD) divers prior to dredging.

Three U.S. Naval time-fuse brass plugs were found at the site, two of which were recovered (Figure 32). This type of fuse was composed of a paper time-fuse encased in a metal stock, sealed with a water-cap, and covered at either end with a safety plug. The cap on this type of fuse screws into the top of the stock and is characterized by three small holes. These holes open to angular channels, which were filled with a powder that was used to convey the flame to the fuse while reducing the possibility of water extinguishing the flame (Bartleson 1972:144; Canfield 1968:10; Gibbon 1860:298; Ripley 1970:275; U.S. Navy Department, Bureau of Ordnance 1866:324).

The fuse plugs recovered from the wreck in 2006 measured 2⅜ inches in length. The diameter of each top was 1¼-inches, while the shanks taper from a diameter of 7/8 inch to 11/16 inch. The tops were stamped with the initials "ORD" and a small anchor, indicating that these were produced for the U.S. Naval Ordnance Department. They were also stamped with a date of 1861 (see Figure 32).

The cultural materials on the seafloor, in many cases, were difficult to identify due to their state of preservation, burial in sediment, or the thickness of the concretion. The wreck site was generally characterized by pockets of small to medium-sized unidentifiable artifacts, large linear concreted iron pieces, and areas of large congregated iron objects. Most of these artifacts are heavily concreted; therefore, all the measurements include this additional thickness. The largest objects observed on the wreck site, aside from the cannon, were two artifacts believed to be components of a tubular return flue boiler. Other artifacts included an iron belt wheel and iron boilerplate. Most of the artifacts encountered during the investigation of the site appear to have been manufactured of iron, with the exception of cupreous hull spikes.

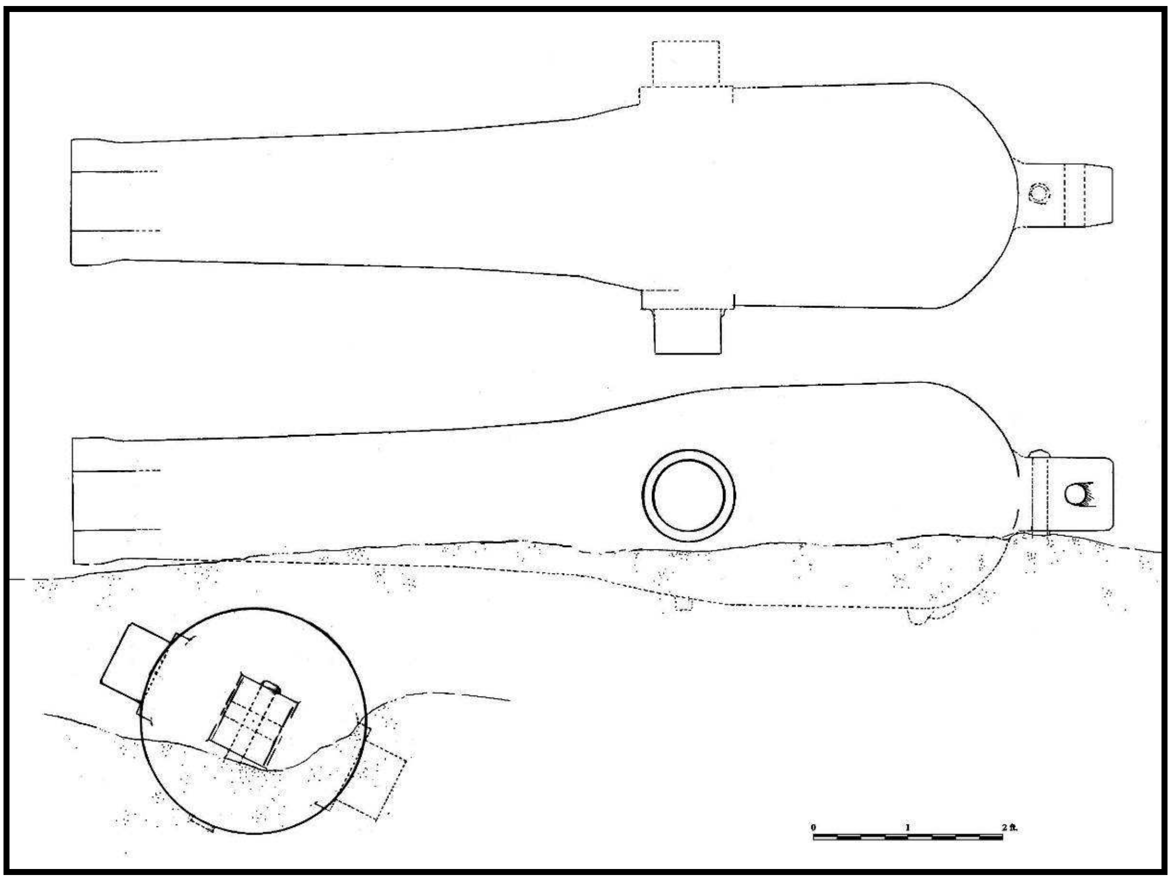

FIGURE 31. *WESTFIELD'S* DAHLGREN CANNON (ARTIFACT 123-001) IN SITU
(DRAWING BY AMY BORGENS)

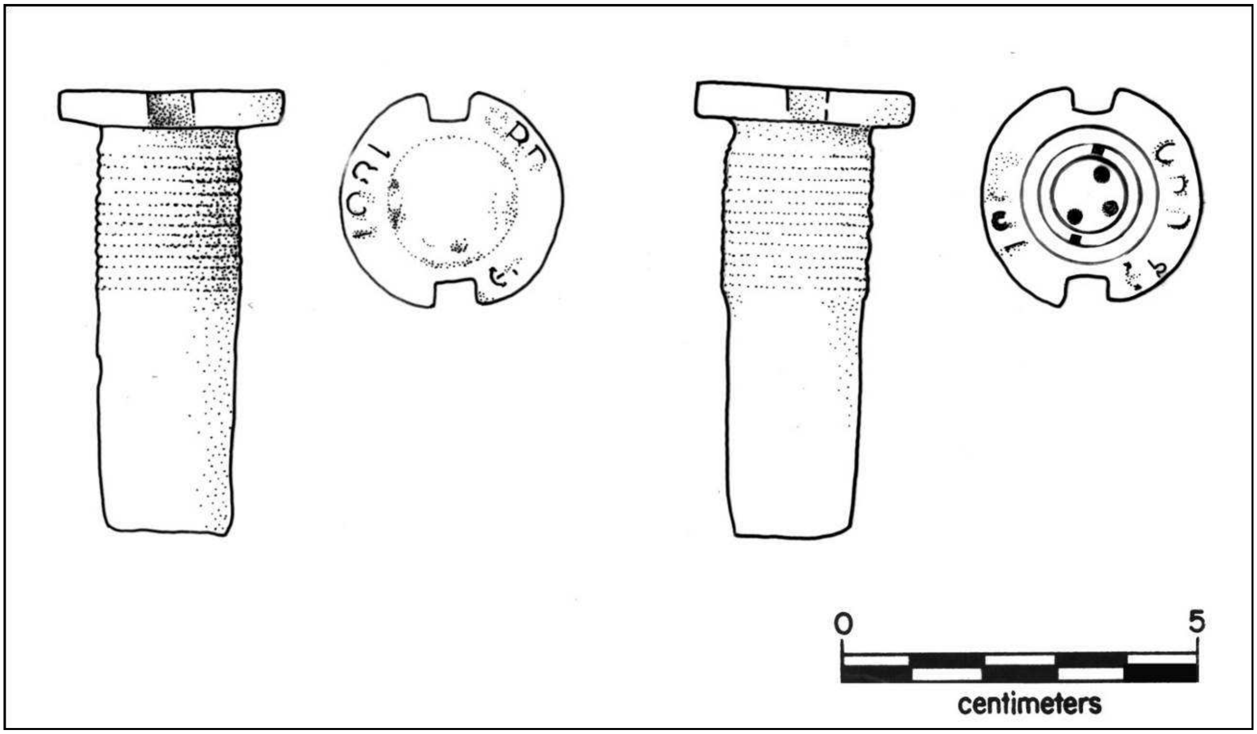

FIGURE 32. FUSES FROM THE WRECK SITE (ARTIFACT NOS. 001 AND 002)
(DRAWING BY AMY BORGENS)

Two large artifacts are believed to be part of tubular return flue boilers. The most complete example of boiler flues from the site consists of two large-diameter pipes connected to the base of a combustion chamber (Figure 33). The artifact was broken at one end and was somewhat centrally located within the debris field. It is the most easily recognizable object in the sonar image (see Figure 28). The overall dimensions of the artifact recorded in 2006 are 10 ft 3 inches long by 6 ft wide. A second large object, measuring approximately 9 by 6.5 inches, is the firebox from one of the boilers. The object consists of two rectangular chambers that contain parallel iron firegrates (one section is disarticulated).

Divers located at least eight boiler mounting brackets. Six were located clustered together in an 11-ft-diameter (3.4-m diameter) area approximately 10 ft north of the firebox (Figure 34). Two more were located more than 30 ft northwest of the boiler flues and spaced 15 ft apart. One of them was broken. These objects measured approximately 2 ft long and 8 inches wide. When used in pairs, these objects could cradle an 8-ft-diameter boiler and keep the intense heat it created away from the ship's wooden hull. Each object has a curved side with two raised edges; this would have created a channel allowing for the dissipation of heat.

FIGURE 33: BOILER FLUES, ARTIFACT 122-001 (DRAWING BY AMY BORGENS)

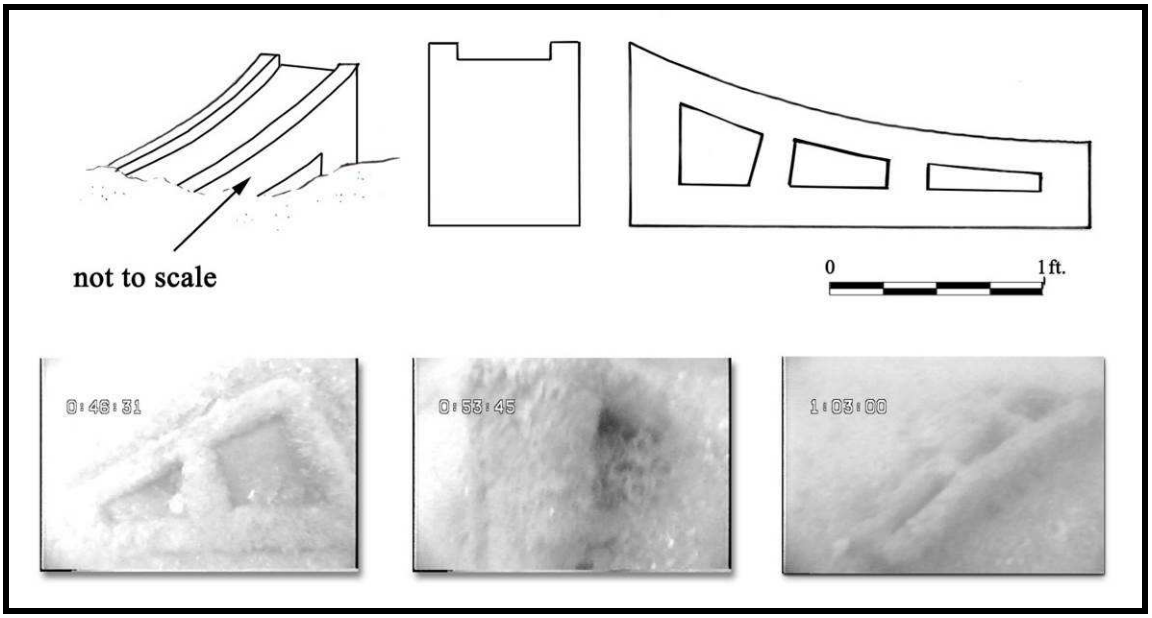

FIGURE 34: BOILER MOUNTS (DRAWING BY AMY BORGENS)

A large bearing block was discovered on the southeast periphery of the wreck site (Figure 35). The main section of the artifact, excluding the projecting fasteners/rods, measured 5 ft, 4 inches x 3 ft, 2 inches. The artifact rested on clay and protruded from the overlying shell hash to a height of at least 12 inches. The configuration of the object suggests it was originally attached to a timber, with parallel through bolts. This artifact is a bearing block used to support one side of the ship's rocker arm at the top of the A-frame.

A large quantity of the recognizable artifact materials located on the wreck site were related to shipboard artillery or to mechanical components of the steam machinery. There are, however, several artifacts that were indicative of the vessel's hull or superstructure. Divers located examples of the protective iron boilerplate originally affixed to the bulwarks. One complete example of boilerplate measured approximately 5 ft by 5 ft. Other artifacts associated with the vessel's structure include cupreous hull spikes, cupreous and iron drift bolts, and a lead hawse pipe. This assemblage of artifacts is entirely consistent with the identification of 41GV151 as *Westfield*.

Mapping the Wreck Site

Despite the site's severe deflation by current scour, important aspects of physical integrity were expected to still be present. For example, prior to the 2006 diving and 2009 recovery effort, it was anticipated that some preservation of lateral artifact provenience could exist, especially in association with the stern. At the time, remote-sensing results suggested that metal artifacts could retain some relation to their original positions, as the approximate size and expected orientation of the hull was reflected in both the magnetometer and sub-bottom acoustic data. There was also the

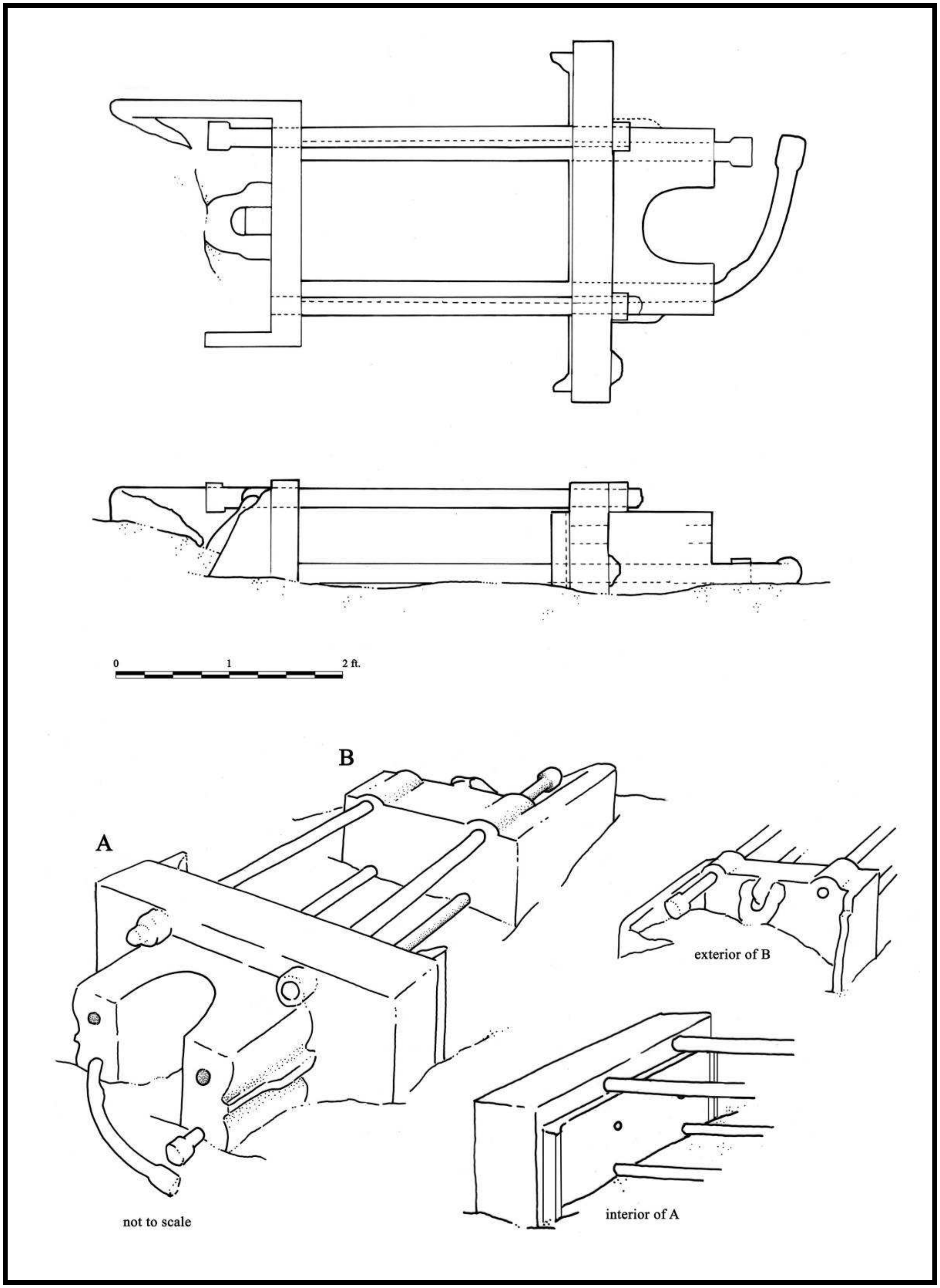

FIGURE 35: BEARING BLOCK (DRAWING BY AMY BORGENS)

chance that larger iron artifacts might shelter small pieces of articulated hull beneath them. One possibility was that copper sheathing from the bottom of the hull remained embedded in the clay where the hull once lay. The preservation of sheathing for example, may have indicated the precise former position of the hull and, if present, would have aided in interpreting provenience of other artifacts. Some of these uncertainties have already been clarified by the 2009 recovery project and are discussed in Chapter 6.

Horizontal Extent of the Wreck: There are some questions about the site that could be addressed even without detailed knowledge of the artifact assemblage and without evidence of extant site features. Horizontal mapping of the wreck site can provide answers to broader questions such as the relationship between the size of the debris field and the original vessel or if the entire wreck is present. While gathering evidence to investigate these questions, Atkins also learned more about the identity and physical integrity of 41GV151 and improved the knowledge of the horizontal positioning of the debris field with respect to the TCC.

Mapping the horizontal extent of the site relied on two types of information: (1) geophysical surveys, including magnetometer, side-scan and sector-scan sonar, and sub-bottom profiler, and (2) visual inspection of the seafloor by divers. Magnetometer surveys ruled out the possibility of any substantial buried wreckage north of the TCC in the vicinity of the site's main debris field. Sonar and sub-bottom profiler data were acquired over a broad area centering on the debris field. The data from these instruments provided a significant amount of coverage in the adjacent channel bottom due to continuous recording of data while turning the survey vessel.

The main debris field was clearly visible in the sector-scan and side-scan sonar imagery from the later surveys (see Figure 28 and Appendix D, figures D-2 and D-3); for these surveys, the sensor was near the seabed. Earlier surveys (e.g., Gearhart et al. 2005; Hoyt et al. 1998; Jones et al. 2002), in which the sensor was towed nearer the water's surface, missed identifying the presence of any sonar target due to the fairly low relief of these objects, combined with the fact that those earlier surveys passed nearly over the top of the debris field, affording a high angle of incidence and no apparent shadow effect.

Improved sonar imagery was acquired in 2005 and 2006 by towing the sensor only 10 to 16 ft above the bottom. The main debris field illustrated in the resulting side-scan sonar image was approximately 164 ft long by 82 ft wide on an axis parallel to the channel. The sonar survey conducted in September 2006 extended the area of coverage over the wreck site and revealed a larger, though less concentrated, debris scatter (Appendix D, Figure D-3). Targets occurred as far away as 820 to 984 ft from the center of the main debris field. These objects appeared as singular large items or small clusters of debris. This wide scatter might have resulted from the explosion of *Westfield* but is also expected to contain some modern debris. The side-scan sonar provided no definitive evidence of debris from the bow either near the main debris field or at a distance of 60 yards from the main wreckage, as suggested by one salvage report (Appendix B, Letter 7).

Acoustic profile data indicated the horizontal distribution of sub-bottom anomalies (Appendix D, Figure D-4). A continuous area of anomalies extended a length of approximately 262 ft parallel to the channel by a width of up to 66 ft. This area was roughly 98 ft longer than the visible debris. The main portion of the visible debris is believed to encompass the former locations of the cabin and stern areas aft of the forward deck. The wide area of sub-bottom anomalies aft of the stern (northwest of the visible debris field) suggests dispersal of material by currents upstream from the wreck. Sub-bottom acoustic data suggest that artifacts associated with the forwardmost 45 ft of the ship could be missing, while buried artifacts closely associated with the stern section might extend 100 ft northwest of the visible debris concentration.

Dive operations to map the horizontal extent of the wreck were completed through a total of 26 dives. The total bottom coverage of dives, excluding Dive 1 for which the USBL system was not yet active, is illustrated in Appendix D, Figure D-5. Diver positions for each 2-second period of 25 dives are represented by individual dots on the figure. In heavily trafficked areas these dots merge into a cloud. All of the larger concentrations of visible artifacts were visited by divers. The positions for individual objects were recorded as Target numbers (see Appendix D, Figure D-6). Objects having the potential to yield diagnostic information were documented by measurements, sketches, and video photography. The distribution of select artifacts is depicted on Figure 36.

The exposed wreckage dimensions obtained from the horizontal mapping of the site were 13–51 ft shorter and 47–63 ft wider than the dimensions of *Westfield*. If one end was blown off as Thompson stated (Appendix A-2, Letter 7), this shortened length is to be expected. Acoustic sub-bottom data, on the other hand, suggested an area of wreckage and/or sediment disturbance exceeding the original size of the ship. Newspaper accounts mentioned that at least two of the ship's guns, one Dahlgren and one 8-inch smooth bore, were thrown 30 ft from the main wreckage by the explosion (*Houston Tri-Weekly Telegraph* 1863a). It can therefore be expected that there was a debris scatter of at least this distance beyond the original hull dimensions. Interpretation of historic accounts in the context of horizontal mapping results suggested that many artifacts lie outside of the main debris field in areas that had not yet been examined prior to D.O. 0005 fieldwork.

Vertical Extent of the Wreck: Atkins used two different procedures for mapping the vertical extent of the wreck site: divers probed the seabed, and a sub-bottom profiler mapped acoustic anomalies potentially indicative of buried wreckage. Ground-truthing of the site through probing located the depth of clay underlying the sediment and shell hash. It was also the method used to

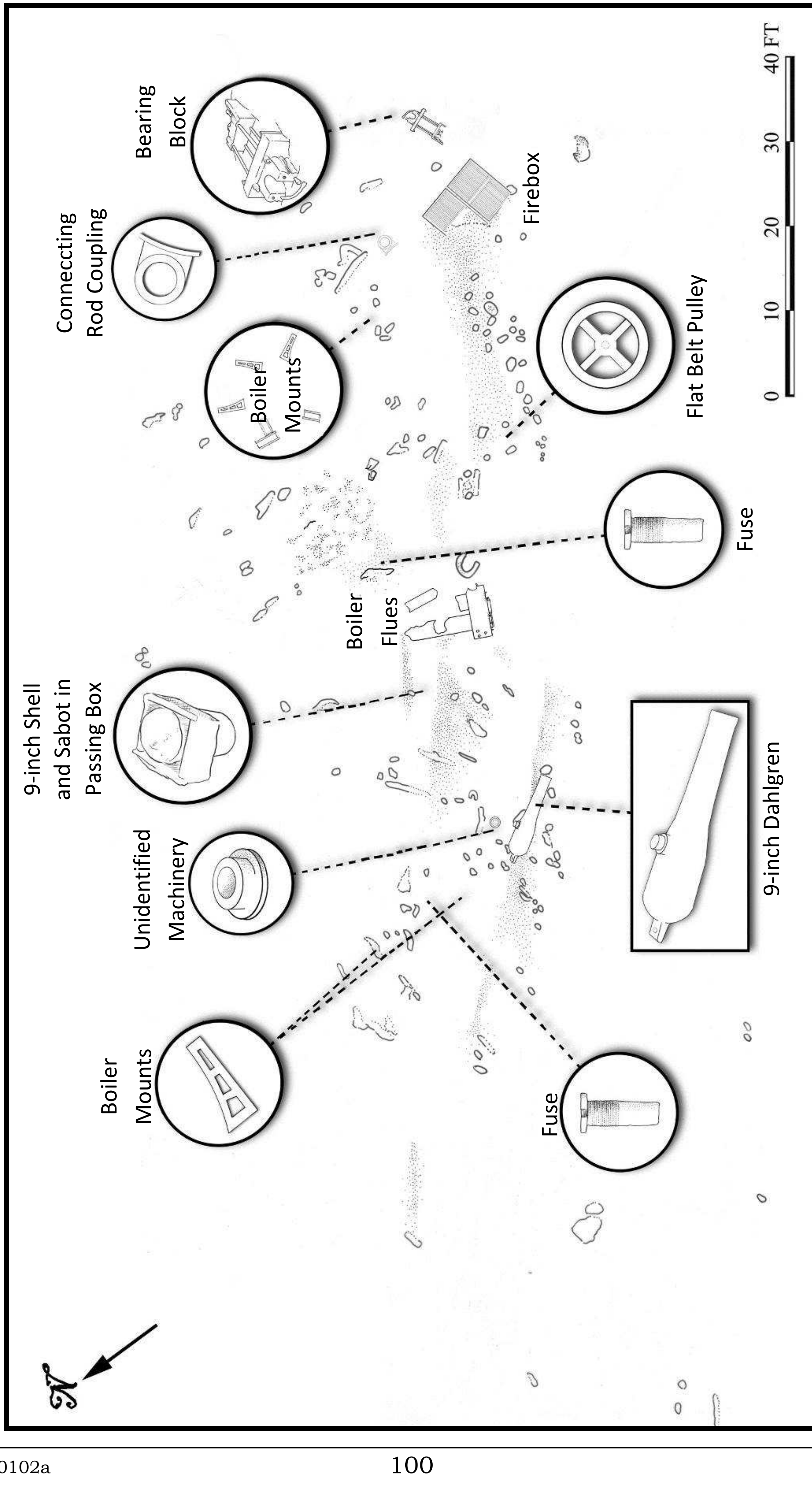

Figure 36. Site Plan (drawn by Amy Borgens)

search for buried hull remains. The acoustic data created by the sub-bottom profiler were able to show depth of burial of some larger artifacts and provide information on the underlying soil substrate. An objective of the vertical mapping exercise was to help determine the impacts of scouring and the downward migration of the wreck on the physical integrity of the site.

A total of 37 probes were placed at various locations across the site (Table 8). The horizontal distribution of probes is illustrated in Appendix D, figures D-7 and D-8. A series of hydraulic probes placed along the apparent axis of the wreckage, as defined by the visible debris field and remote-sensing data, demonstrated a low probability of finding any intact hull remains. Divers attempted a probe depth of at least 6 ft below the seabed at regular intervals without striking any buried cultural materials. At least two levels of clay sediment were consistently detected both inside and outside the debris field at depths of approximately –47 ft and –49 ft USACE MLT.

Both clay layers were penetrated with difficulty; however, the lower clay horizon was particularly resistant to probing. All clay was of a light gray color typical of submarine deposits. There was no evidence of oxidation to suggest either layer might be associated with the Pleistocene-aged Beaumont clay. Wreckage observed by the divers appeared limited in depth of burial to the upper foot of sediment consisting principally of shell hash.

Acoustic sub-bottom anomalies were mapped using a CHIRP sub-bottom profiler as described in the field methods. Several representative cross sections of sub-bottom data over *Westfield* are illustrated on Figure 37. Interpretation of the sub-bottom profiles recorded over the site vicinity revealed a substantial area of shallow subsurface anomalies somewhat exceeding the size of the *Westfield*'s hull (see Appendix D, Figure D-4). The lateral extent of these anomalies exceeds the area of wreckage exposed on the seabed but is consistent with the expected total size of the site. The largest and most continuous of these anomalies are horizontal reflectors concentrated within the upper 1.5 ft of the sediment column.

These reflectors occur at about the same depth as the upper layer of clay encountered by divers when probing the seafloor. Above the clay is fine loose shell hash. There are iron artifacts of various size scattered around the site within the upper foot of sediment. No artifacts were found below that level, and extensive diver probing between 6 and 10 ft did not reveal any hull remains.

The clay extends laterally beyond the artifact scatter and was believed to be a natural estuarine deposit dating from the filling of the Trinity River Valley. The shallow horizontal reflectors in the sub-bottom profiles, on the other hand, were limited to the vicinity of the artifact scatter and thus were not believed associated with the clay. The most likely explanation for these shallow anomalies was perceived as the reflection off of scattered iron artifacts that only appear as a continuous reflector because of the number and proximity of such artifacts.

TABLE 8. PROBE DEPTHS AND RESULTS

Probe	Method	Total Depth (ft)	Results (depths below seabed)
P.12	¼-inch air jet	1	clay at 1 ft
P.13	¼-inch air jet	1	clay at 1 ft
P.14	¼-inch air jet	1	clay at 1 ft
P.15	¼-inch air jet	1	clay at 1 ft
P.16	¼-inch air jet	1	clay at 1 ft
P.17	¼-inch air jet	2	clay at 1 ft; clay? at 2 ft
P.18	¼-inch air jet	1	clay at 1 ft
P.19	¼-inch air jet	1	clay at 1 ft
P.20	¼-inch air jet	0.5	metal at 6 inches
P.22	¼-inch air jet	2.5	clay at 1 ft
P.25	¼-inch air jet	3	clay at 2 ft
P.26	¼-inch air jet	2.2	clay at seabed & 2 ft
P.29	¼-inch air jet	1.2	clay at 1 ft
P.31	pneumatic auger	3	clay at 1 ft & 3 ft
P.32	pneumatic auger	3.5	clay at 1 ft & 3 ft
P.33	6-ft hammer-driven rod	3	clay at 1.5 ft
P.34	6-ft hydraulic	6	material not reported
P.35	6-ft hydraulic	6	material not reported
P.36	6-ft hydraulic	0	metal at seabed
P.37	6-ft hydraulic	5.5	clay at 1 ft & 3 ft
P.38	6-ft hydraulic	6	clay at 1 ft & 3 ft
P.39	6-ft hydraulic	6	material not reported
P.40	6-ft hydraulic	6	material not reported
P.41	6-ft hydraulic	6	material not reported
P.42	6-ft hydraulic	6	material not reported
P.44	6-ft hydraulic	6	clay at 1 ft BS
P.45	6-ft hydraulic	6	clay at 1 ft & 3 ft
P.46	6-ft hydraulic	3	clay at 1 ft BS
P.47	6-ft hydraulic	6	clay at 1 ft & 3 ft
P.101	10-ft hydraulic	10	clay at 1 ft & 3 ft
P.103	10-ft hydraulic	10	clay at 1 ft & 3 ft
P.104	10-ft hydraulic	10	clay at 1 ft & 3 ft; softer at 5.5 ft & 8 ft; clay at 9 ft
P.106	10-ft hydraulic	10	clay at 1 ft, 2.5 ft, 7 ft & 8 ft
P.107	10-ft hydraulic	10	shell hash over clay at 6 inches; shell at 5.5 ft
P.109	10-ft hydraulic	10	shell hash over clay at 6 inches; clay at 3 ft; shell at 5.5 ft
P.111	10-ft hydraulic	3	clay at 1 ft BS
P.113	10-ft hydraulic	10	multiple clay layers

Occasional discontinuous sloping anomalies appear at apparent depths of up to 5 ft below the seabed. These were believed to be parabolic reflections from large iron artifacts located on the seabed as far as 20 ft laterally from the nadir (point on the seafloor directly beneath the transducer). Any iron artifact ensonified by the acoustic beam of the CHIRP profiler might register as an anomaly on the sub-bottom record; however, an artifact's reflection is always assigned a geographic position directly beneath the transducer at the moment the reflection is received. The beam transmitted by the system is free to propagate downward in all directions, and thus will reflect from iron artifacts located well to the side of the transducer. The system cannot sense the direction from which a sound wave arrives so assumes they all propagate straight upward from the seabed. Because the travel time of a sound wave from these off-center artifacts is longer than for an object directly below the transducer, side-lobe reflections are mapped deeper in the sediment column than they actually occur.

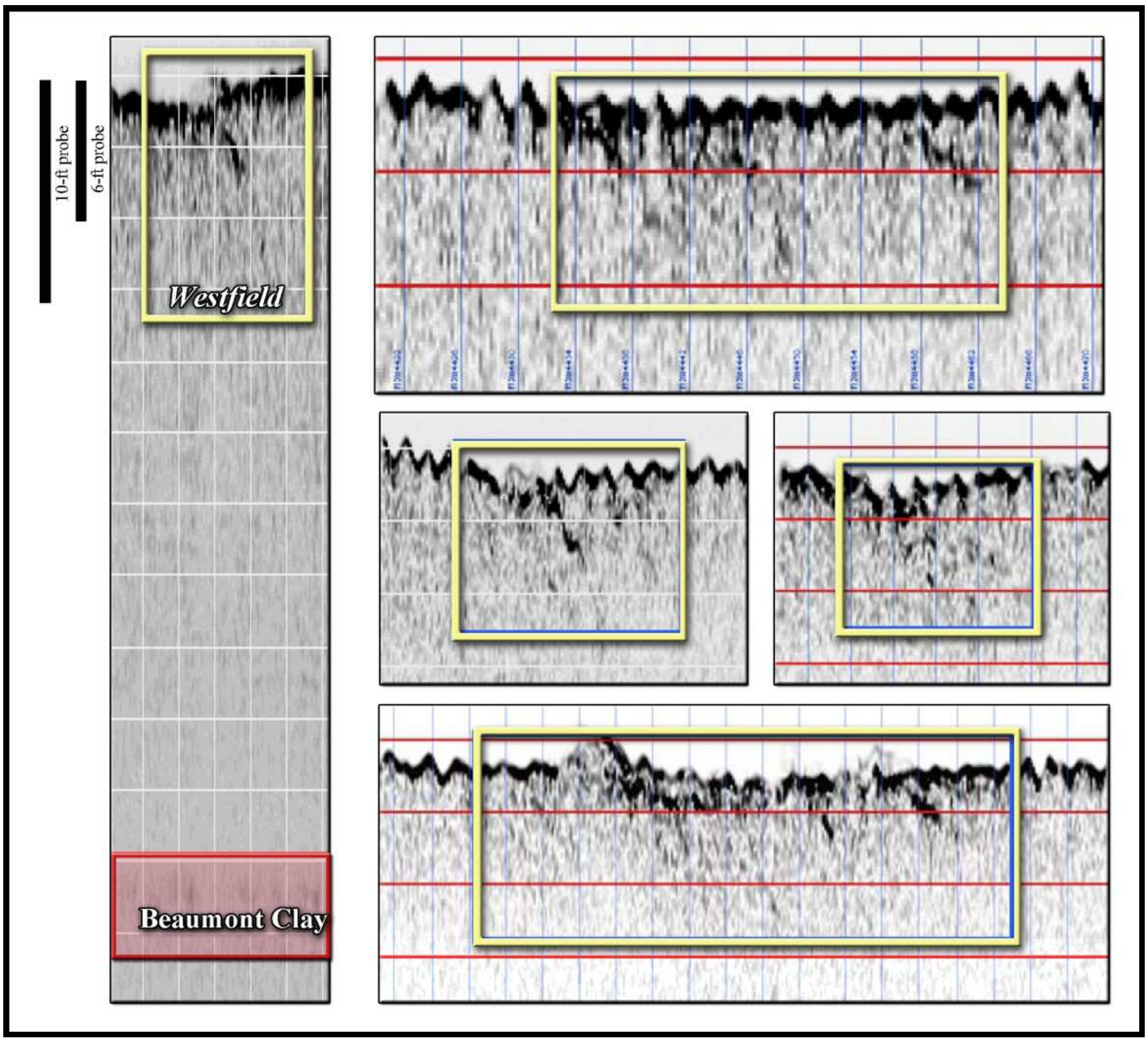

FIGURE 37. CHIRP SUB-BOTTOM PROFILE RECORD OF *WESTFIELD* (YELLOW BOXES). TYPICAL 10-FT AND 6-FT DIVER PROBE DEPTHS ARE SHOWN AS BLACK BARS ON THE SIDE OF THE PROFILE. HORIZONTAL SCALE LINES 1 M APART.

Summary and Conclusions

The investigation of 41GV151 conducted under D.O. 0005 provided overwhelming evidence confirming the wreckage as that of USS *Westfield*. A substantial amount of cultural material was found lying on and near the seabed, including two U.S. Naval brass fuse plugs stamped 1861 (Figure 32), which were the first two artifacts recovered from the site by archeologists. The lateral extent of exposed wreckage documented by these investigations measured approximately 82 by 164 ft and consisted nearly exclusively of disarticulated metal artifacts, including a 9-inch Dahlgren cannon, boiler fragments, iron boilerplate, numerous cannon shot, and assorted fasteners. Small nonperishable ceramic artifacts also were observed.

Investigation of the site did not locate extant hull remains or wooden artifacts. The hull of *Westfield* was largely and perhaps completely gone, indicating that all material suitable for burial of a wreck had washed away, leaving only a dense layer of nearly impenetrable estuarine clay. Intense currents caused by tropical storms likely have repeatedly exposed lower portions of the wreck to biological, mechanical and chemical degradation while breaking down already degraded wooden structures. Normal diurnal tides might have prolonged exposure of the wreck to biological and chemical agents during the periods between tropical storms. In any case, diver probes did not encounter hull remains, thus suggesting *Westfield* had been exposed for a sufficient length of time to cause complete disintegration of the hull.

Magnetometer and sub-bottom acoustic data left little doubt that a substantial number of iron artifacts are shallowly buried outside of the main sonar debris field investigated by these combined studies. Perhaps most significantly, a suspected concentration of buried artifacts southeast of the visible debris field is believed associated with the forward section of the ship. The lack of exposed artifacts in the bow area suggests that artifacts there are small enough to be buried by the upper foot or so of sediment. The apparent dearth of larger artifacts in the southeastern portion of the main wreck anomaly might be attributed to the fact that the bow exploded, dispersing artifacts in all directions and breaking the hull in two pieces. Confederate salvage of the stern likely was more thorough and systematic than forward of the machinery, due to the presence of intact compartments below the water level. Today one might expect relatively fewer artifacts associated with the original contents of the vessel in the bow area. On the other hand, artifacts associated with the ship's construction, including hull fasteners and copper sheathing, might be more abundant in the aft portion of the site and should retain a higher accuracy of lateral provenience there than similar artifacts from the forward half of the ship owing to the fact that the aft hull survived the explosion and deteriorated in place.

Numerous unexplored side-scan sonar targets and buried magnetic anomaly sources also existed in the bottom of the TCC at distances of up to 1,000 ft from the debris field investigated under D.O. 0005. Among the artifacts that were suspected to be scattered across the channel bottom were numerous examples of UXO. UXO is hazardous to dredging operations and would have to be located by archeologists and removed by qualified military EOD divers prior to dredging the channel.

Remote-sensing results suggested that the downward migration of the site has not completely upset the horizontal distribution of the remaining wreckage. The lateral distribution of sub-bottom acoustic anomalies is consistent with the dimensions of *Westfield*, suggesting that the vessel and its contents deteriorated on this precise location as years of current scour removed underlying sediments. The results of D.O. 0005 led Atkins to conclude that *Westfield* demonstrates sufficient historic significance, historic context, and historic integrity to make it eligible for listing in the NRHP (see also Chapter 8). The USACE determined that *Westfield* is eligible for the NRHP and requested concurrence of the Texas SHPO in 2006. Both the SHPO and NHHC concurred regarding eligibility in 2007 (Appendix C-4).

Recommendations

In the opinion of the authors, the historic significance of *Westfield*, necessitated some level of additional fieldwork to mitigate the effects of the TCCIP on the site (Gearhart et al. 2007). As mandated by Section 106 of the National Historic Preservation Act, the USACE would have to consider the effects of that project on the site. Dredging to a minimum elevation of –50 ft USACE MLT, as proposed for the TCCIP, would effectively remove the upper 4 ft of sediment from the site. Since artifacts seem limited approximately to the upper foot of sediment, deepening as proposed would remove all portions of the site lying within the TCC.

The U.S. government owns the remains of *Westfield*, since it was an active military vessel when it wrecked. Since *Westfield's* discovery, the U.S. Navy History and Heritage Command (NHHC) has been an active partner in historic preservation of the site. The USACE executed a Programmatic Agreement with the Navy and the THC for the purpose of coordinating on historic preservation of military vessels such as *Westfield*. Subsequent archeological work on *Westfield* involved all three agencies in the planning process.

Atkins suggested that future study should proceed relatively quickly to minimize the potential for looting of the site, since its discovery and general location became apparent to the public during the period of the D.O. 0005 fieldwork. A number of recommendations for future archeological investigation were suggested and are presented below. These are reprinted from Gearhart et al. (2007) and arranged in the recommended order of their implementation.

1. *Survey nondredged portions of the TCC*. Close-order remote-sensing survey of the TCC channel bottom is recommended. Past surveys have been limited to areas above the channel toe. Portions of the channel bottom that have never been dredged have potential to harbor undiscovered historic shipwrecks and/or portions of the *Westfield* artifact assemblage, including UXO. UXO is hazardous to dredging operations and should be systematically removed prior to dredging in order to minimize down time and damage claims for the dredge. For purposes of locating other shipwrecks and according to Texas Administrative

Code Title 13, Part 2, Chapter 28, a magnetometer sensor should be towed no more than 20 ft off the seabed along transects spaced no greater than 60 ft apart. For purposes of locating UXO, a magnetometer sensor should be towed 10 ft above the seabed along transects spaced 10 ft apart. The shipwreck survey should include all portions of the TCC that have never been dredged. The ordnance survey should extend both up and down the TCC at least 300 ft from the center of *Westfield*'s main debris field. Both surveys should extend from one channel toe to the other and include a 50-ft buffer on either side. Side-scan sonar coverage should provide the maximum resolution possible with a 500-kHz system, while achieving at least 200 percent coverage (i.e., two complete views of all areas surveyed).

2. *Conduct additional archival research*. Additional archival research might identify materials relevant to the historic significance of *Westfield*. Such materials would contribute valuable historic context and aid the formulation of research questions necessary for development of a mitigation plan. Research topics might include, but are not limited to, the military career of *Westfield*; methods and materials for construction (e.g., as-built drawings if in existence) of *Westfield* or similar Staten Island ferries; methods and materials for military conversion of ferryboats during the Civil War; and Morgan Ironworks vertical walking beam engines of similar size and age as used on *Westfield*. Potential research facilities may include, but are not limited to, the New York Historical Society; the Staten Island Historical Society; the Staten Island Institute of Arts and Sciences; the New York City Department of Records; the New York State Archives (Albany); the Museum of the City of New York; the New York Public Library; the National Archives and Records Administration (Washington, D.C. and New York City); and the NHHC (Washington, D.C.). To the extent possible, specific research materials should be identified through correspondence and online searches in order to prioritize research objectives prior to traveling.

3. *Draft an archeological treatment plan to guide mitigation*. An archeological treatment plan will need to be formulated prior to initiating mitigation of *Westfield*. This plan will include relevant research questions developed by the USACE in consultation with the NHHC and the THC. Those research topics will guide the direction of all future archeological site mitigation.

4. *Draft a plan for selection of artifacts to be conserved and for disposition of nonconserved artifacts*. This document would be an important component of the archeological treatment plan. Since all artifacts within the channel ultimately would be displaced by dredging, barring their removal by archeologists, it is prudent to have all of them removed in a controlled manner. Thus, all artifacts should be brought to the surface by archeologists to allow close inspection and photography under proper lighting. It is neither feasible nor necessary, however, to conserve every artifact from *Westfield*. Prior to bringing any artifacts to the surface, it is important for all responsible parties to agree on guidelines for selecting artifacts to be conserved. Any such guidelines must be sufficiently flexible to allow for unanticipated discoveries or research questions, but they also should be specific enough to aid in preparation of conservation and curation budgets. The plan also should identify a location for placement of nonconserved artifacts that would provide for their long-term stability while allowing access to future researchers. It is anticipated that such a document would be prepared by the USACE, taking into consideration the research questions

developed under Item 3 above, then reviewed by and negotiated with archeologists representing the THC and the NHHC.

5. *Formulate and implement a plan for removal of UXO by Explosive Ordnance Disposal (EOD) divers*. A plan must be coordinated between the USACE and EOD experts concerning the removal of all UXO from the site prior to dredging. Such work must be conducted by military EOD divers. The timing and integration of UXO removal with respect to archeological mitigation plans must be agreed upon by all responsible parties prior to initiating this task.

6. *Placement of a fixed dive platform adjacent to the site*. The efficiency of all future diving efforts would benefit greatly by the placement of a suitable fixed dive platform, such as a spud barge, adjacent to the TCC for the duration of such work. A fixed dive platform could provide a large stable work environment with room for artifact processing in all normal weather conditions, while minimizing time spent daily on mobilization of operations. Permission to place such a facility would need to be coordinated with the USCG.

7. *Incremental removal of loose shell hash from main site debris field*. The results of these studies indicate that all artifacts are resting on a layer of dense clay at or near the seabed. The only sediment overlying this clay is a fine, loose shell hash. This material must be moved in order to map and document the underlying artifacts; however, because the shell hash is ubiquitous and subject to movement by the tidal current, it seems advisable to uncover small areas of the clay at any one time. A single diver manually operating either an air lift or a hydraulic induction dredge should be able to temporarily displace this material from small sections of a site grid at a sufficient rate to stay ahead of documentary activities (outlined under steps 8 and 9 below).

8. *Detailed mapping and photography of artifacts in situ*. As the site is incrementally uncovered (Step 7 above), archeologists would map and document artifacts in situ. Two possible options for mapping the site include using a USBL underwater positioning system as a stand-alone mapping tool, or using a site grid in combination with a USBL system. The degree of lateral artifact provenience has yet to be determined; thus, selection of the most suitable methodology and resolution for mapping should initially err on the side of highest accuracy, which would be by establishing a site grid. Documentation of the site should begin in the suspected stern area where the potential for lateral movement of artifacts arguably is lowest. If initial efforts in the stern area determine that the lateral artifact distribution lacks integrity, then the balance of the effort could quickly and easily change over to a lower mapping resolution utilizing a USBL system to map artifacts prior to their removal. An efficient method of mapping on a grid system would involve the temporary placement of rigid grid frames (e.g., built of iron pipe) over portions of the site as they are uncovered. Grid frames could be anchored to the seabed by driving metal stakes at each corner. The large grid frames could be subdivided into any desired size of smaller grid units for more-precise mapping within a square. Corner stakes would be left in place and used to anchor adjacent grids as frames are "leap-frogged" across the site. Geographic coordinates for each corner could be mapped precisely using a USBL system, such as was used to position divers under D.O. 0005. Precision and repeatability of geographic coordinates could be greatly improved by use of Real Time Kinematic (RTK) GPS to position the USBL transceiver on the dive platform. Mapping of artifacts could be accomplished using a digital camera mounted at a fixed height and designed to slide on runners across a grid at intervals set to provide

overlap between adjacent photographs. As photographs are brought to the surface, they would be immediately checked for quality, correlated with the proper grid coordinates, and added to a photographic mosaic of the site by personnel on the dive platform. Production of a photographic mosaic would not be feasible using a USBL mapping system by itself.

9. *Controlled artifact collection*. Once artifacts have been photographically (or otherwise) mapped on the seabed, and their positions verified and added to the site plan on the surface, they could be brought to the surface for closer inspection. Exceptions would include UXO and any artifacts too heavy for divers to safely lift.

10. *Artifact photography, cataloging, and stabilization (as brought to the surface)*. Artifact specialists on the dive platform would photograph, measure, and catalogue each artifact as it is recovered and brought to the surface. The artifact guidelines established under Step 4 above would be applied to each artifact. Those obviously requiring conservation would be stabilized in a water-filled tank of materials destined for a conservation facility. Artifacts not to be conserved would be stabilized in a separate tank of materials to be placed at a predetermined location for long-term storage. Any ambiguous materials of potential interest would be assumed destined for conservation until further study and consultation could aid that determination.

11. *Lifting of heavy artifacts from the seabed*. Once all other artifacts have been removed from the seabed, a barge or boat with heavy lifting capability would be required to bring the cannon (and possibly a few smaller items) to the surface.

12. *Search for hull fragments and other artifacts beneath heavy artifacts once removed*. Heavy items, including the cannon, parts of the boilers, and iron boilerplate, might have moved relatively little over the years, thereby offering protection to underlying artifacts, or possibly even preserving small fragments of the lower hull. Once these heavy items have been removed from the seabed, the underlying areas should be thoroughly examined for such materials. For example, the *Westfield*'s hull was sheathed in copper to protect it from marine organisms. Much copper was salvaged by the Confederacy; however, copper from the bottom of the hull probably was inaccessible. There is no evidence to indicate the hull was completely broken up and removed by salvage efforts, thus there is a possibility that copper sheathing remains embedded in the surface of the clay. The discovery of copper sheathing marking the original hull position would be invaluable to determining integrity of artifact provenience. In the event that copper is neither discovered beneath heavy artifacts nor uncovered by Step 7 above, then a limited effort should be conducted to locate copper sheathing by retrieval of shallow sediment cores using a manual coring device.

13. *Repeat steps 6 and 7 for channel-bottom anomalies*. Once the main portion of the *Westfield* site has been mapped and the artifacts have been lifted, the nearby anomalies in the TCC bottom could be identified, mapped, and documented (if historic). Such areas would not require a site grid; rather they could be mapped using the USBL system. Substantial time savings could be achieved during this task by using relatively new technology known as a diver-held acoustic camera to locate exposed objects in low visibility. Discovery of buried objects in the channel would best be facilitated by use of a diver-held magnetic gradiometer.

14. *Finalize artifact conservation list and implement nonconserved artifact plan (see Step 4 above)*. Once all artifacts have been removed from the site, the list of those requiring

conservation can be finalized, and artifacts can be delivered either to a conservation facility or to a predetermined location for long-term stabilization and storage.

15. *Repeat of close-order magnetometer survey in channel to clear for dredging*. Once all known UXO and other artifacts have been removed from the channel, a follow-up magnetometer survey is recommended to verify that no UXO was missed by EOD divers.
16. *Design and construction of a museum display*. Mitigation of *Westfield* should include the design and construction of a museum display to document the history of this important ship for the benefit of the public. A museum display might include a display of the cannon, ordnance, and other select artifacts, a scale model of *Westfield* outfitted for military service, and storyboards documenting *Westfield*'s contribution to military history, its pivotal role in the Battle of Galveston, and its status as a military war grave. Texas City has expressed interest in having a display of *Westfield* artifacts in their city. Any such display would require Texas City and the Navy to develop a long-term loan agreement allowing use of the Navy's artifacts in a museum.
17. *Curation*. USACE mitigation efforts will provide for initial conservation and accessioning of artifacts into a repository; however, it is the responsibility of the U.S. Navy, as the owners of *Westfield*, to provide for permanent curation of those artifacts selected for conservation at an approved curatorial repository.

Westfield Ordnance Survey, Texas City Dike Groins Survey, and Archival Research (D.O. 0006)

In an effort to begin implementing some of the archeological recommendations resulting from D.O. 0005, the USACE authorized additional investigations of Westfield under D.O. 0006 (THC Antiquities Permit No. 4622) (Borgens, Hudson et al. 2007). The first project objective was a close-order magnetometer survey of site 41GV151 as a means to determine the distribution of metal artifacts on the seafloor (Figure 38). At this phase of the *Westfield* project, the methodology for artifact collection was proposed to be diver mapping and recovery. Civil War–era ordnance is considered "live" and has special handling procedures and regulations. It can also pose a hazard to dredging operations if left on the seafloor. The 2007 survey was designed to increase survey resolution over the site as a means to better indicate the density of smaller ferrous objects that could be associated with live ordnance frequently referred to as Munitions and Explosives of Concern (MEC). Previous diving on *Westfield* already identified examples of such artifacts at the site.

The second project objective included a marine remote-sensing survey of the proposed TCC dredged material placement area at the Texas City Dike Groins (see Figure 38). That survey was conducted concurrently with the ordnance survey, and covered a 166-acre (67-ha) area adjacent to the eastern tip of the Texas City Dike.

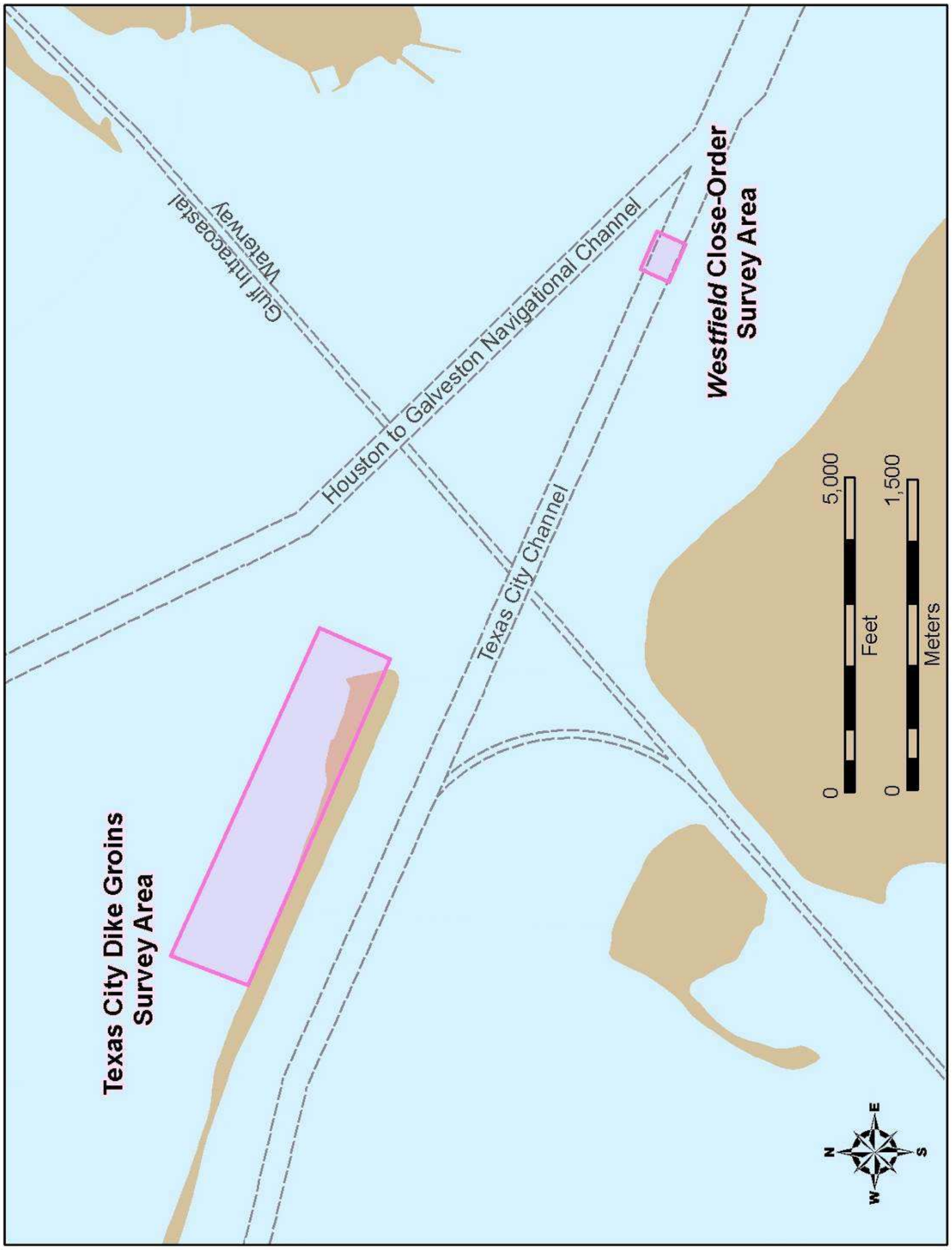

FIGURE 38. D.O. 006 SURVEY AREAS

ATKINS

The third objective of D.O. 0006 was detailed archival research on *Westfield* or similar era steamships and/or steamship construction to support the NRHP recommendation and aid in identification of site features and/or artifacts. Atkins visited research facilities in Washington, D.C., New York City, and Galveston, Texas.

Methods

Remote-sensing Surveys

Data acquisition and processing methods for both the *Westfield* ordnance and the Texas City Dike Groins surveys were similar to the methods used in previous remote-sensing surveys conducted under D.O.s 0004 and 0005 (see previous discussion). The survey vessel was the *PeeWee McKinney*, and additional survey equipment included an EG&G Geometrics G-882 cesium magnetometer, an EdgeTech 4200 side-scan sonar with a CODA data acquisition system, and a Trimble Navigation Limited™ Ag132 DGPS. Trimble's HydroPro (version 2.1) software provided navigation guidance and position data logging. The navigation software was configured to log magnetometer and DGPS data simultaneously. Horizontal positions were based on the Universal Transverse Mercator (UTM) Coordinate System, Zone 15 North. The side-scan sonar was set to image the bottom for a distance of 82.0 ft on either side of the survey vessel. The navigation software calculated and recorded position estimates for the magnetometer sensor in real-time.

The close-order *Westfield* site survey was performed by Robert Gearhart, Doug Jones, and Dan Hudson on July 23–25, 2007. This survey was designed to collect additional magnetometer data at both decreased line spacing and an increased equipment tow depth in order to maximize the quality of data collected from the wreck debris field. The survey data were collected in order to better define the limits of the wreck and associated debris, including evidence for individual examples of ordnance. Survey transects were spaced a maximum of 10 ft apart, and maximum magnetometer sensor height off the seabed was also approximately 10 ft. The magnetometer sensor was towed 105.1 ft aft of and in line with the DGPS antenna at an average depth of 38 ft. The side-scan sonar sensor was towed 3.6 ft to port of the DGPS antenna at an average depth of 30 ft. The survey was conducted at speeds averaging 1.5 to 3.5 knots (1.7 to 4.0 miles per hour for deep tow).

The Texas City Dike Groins survey was conducted by Doug Jones and Dan Hudson on July 26 and 27, 2007. Average transect spacing did not exceed 33 ft. During most of this survey the magnetometer sensor was towed on the surface approximately 72 ft aft of and in line with the DGPS antenna. The side-scan sonar sensor was towed 3.6 ft to port of the DGPS antenna at a depth of approximately 8.0 ft. The tow point was positioned as far to the vessel's stern as possible to minimize wave motion affecting the sonar sensor, yet the sensor was kept forward of the propeller's bubble stream. The bubble stream is acoustically reflective and would attenuate the sonar signal. The survey was conducted at speeds averaging from 4 to 5 knots (4.6 to 5.8 miles per hour) for surface-tow.

Archival Research

Two regional areas were the focus of archival research: the U.S. Naval Records at NARA in Washington, D.C., and several locations in New York City. New York City was the location of *Westfield*'s builder, its use (Staten Island Ferry Co.), and its conversion to a naval gunboat (under the auspices of the New York Navy Yard). Research in Washington, D.C., and New York City was conducted by Doug Jones and Amy Borgens, respectively, in June and August 2007.

Results

Westfield *Ordnance Survey*

The magnetometer data collected over the site showed a large distribution of ferrous objects (Figure 39). Any of the anomalies illustrated on Figure 39 might be associated with live ordnance and/or other scattered wreckage from *Westfield*. The scatter of anomalies continues to the margins of the area surveyed in all directions, indicating that wreckage might extend beyond the area shown. The close-order survey conducted in July 2007 increased the magnetometer data resolution significantly in comparison with earlier surveys. Atkins had performed a similar survey over the wreck site in April 2007 utilizing 65-ft transect spacing (Borgens, Hudson et al. 2007). A comparison of the respective data sets is illustrated on Figure 40a and 40b. An enlarged image of the magnetometer data for the wreck itself is illustrated on Figure 40c. The two sets of survey lines are overlaid for comparison of resolution on Figure 40d.

The magnetometer results demonstrated that a significant amount of ferrous objects or debris not identified in earlier surveys extended to and surpassed the confines of the project area. The data recorded during the 2007 investigation was perceived to be indicative of the nature of the wreck event itself: the purposeful explosion of the vessel that transported part of the steamer a distance of approximately 55 m (60 yards) (Appendix A-2, Letter 7). The presence of potential live ordnance in areas of the TCC modifications poses a significant hazard to the proposed work. In order to avoid potential dredging delays, it was recommended that the survey area be expanded along the TCC until the apparent edge of debris is conclusively defined (Borgens, Hudson et al. 2007).

In 2009, the data were examined again in more detail prior to planning the artifact recovery diving operations. At that time the Principal Investigator identified a dipolar magnetic anomaly within the ordnance survey area that exhibited characteristics consistent with anomalies recorded over known shipwrecks. This anomaly was given the label Target 1 (see Figure 39), and was one of two anomalies recommended for further remote-sensing investigation by a remotely operated vehicle (ROV) and sector-scan sonar, as part of a prediving target assessment in April 2009 (under D.O. 0006, Modification 1). That survey is discussed in detail in Chapter 6.

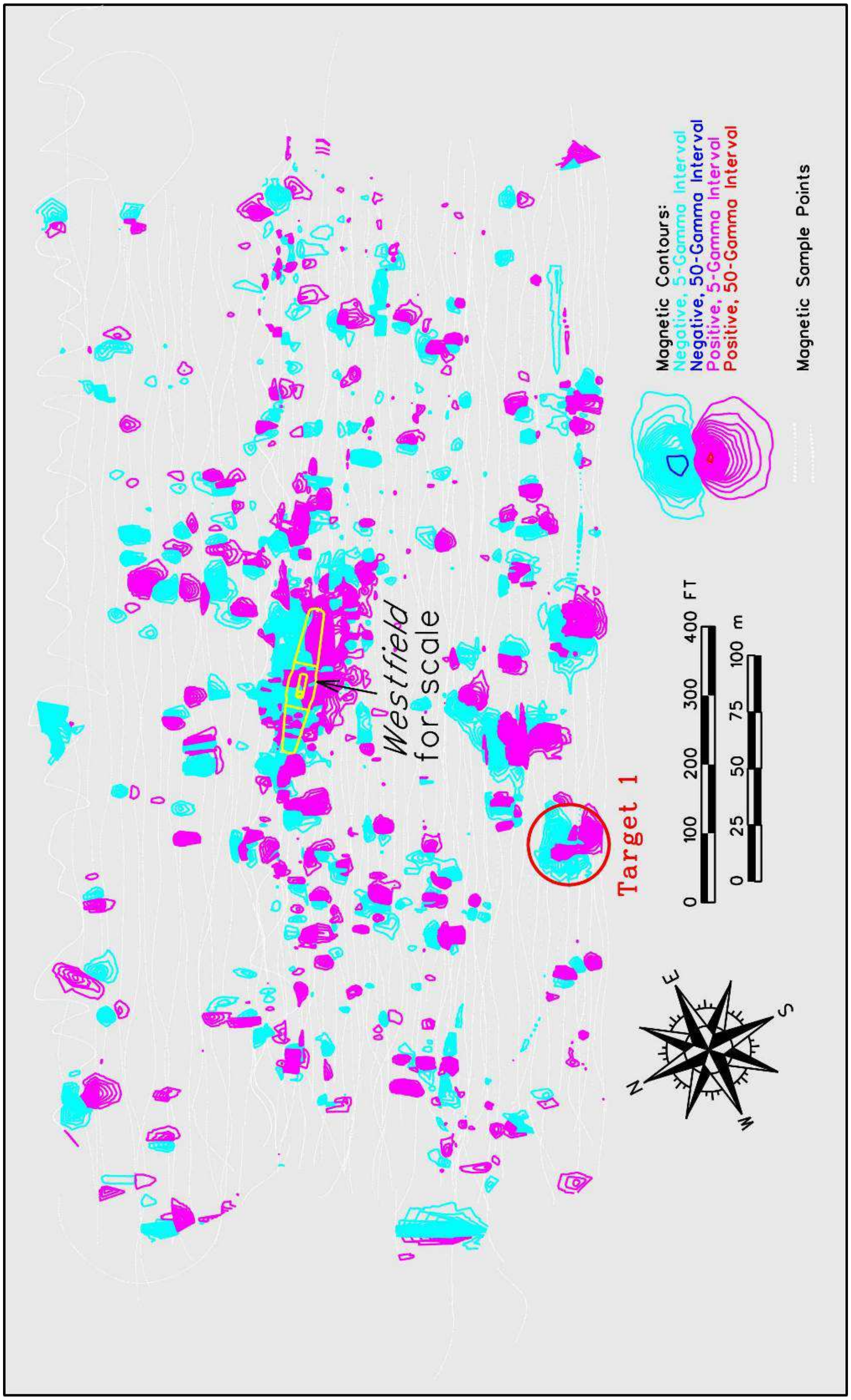

FIGURE 39. USS *WESTFIELD* ORDNANCE SURVEY.

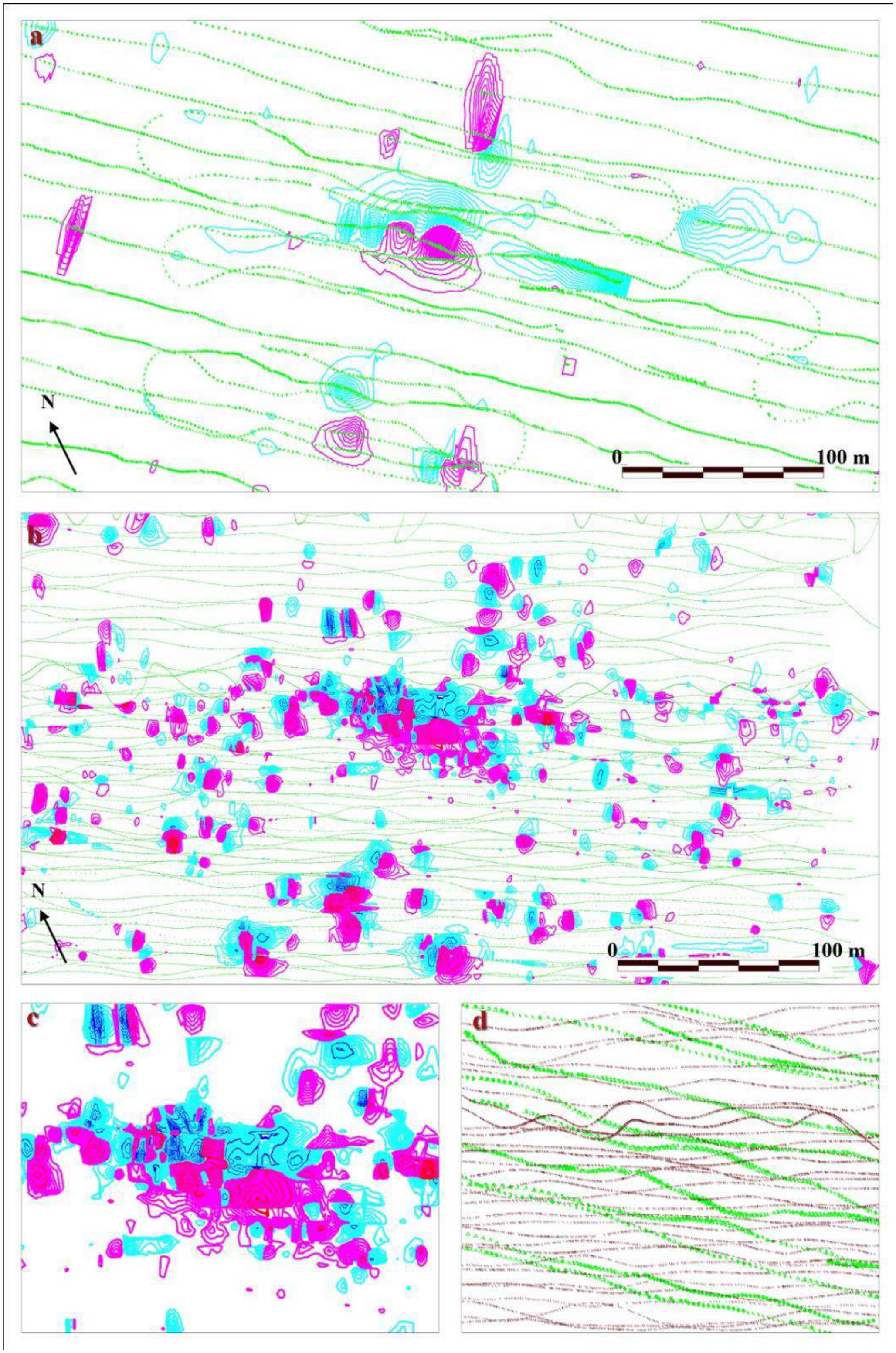

FIGURE 40. SURVEY OF USS *WESTFIELD* FROM (A) APRIL 2007 AND (B) JULY 2007; (C) DETAIL OF THE MAIN WRECK SITE; (D) COMPARISON OF SURVEY LINE RESOLUTION FROM APRIL 2007 (GREEN) AND JULY 2007 (BROWN).

Texas City Dike Groins Survey

A single magnetic anomaly (M1) was located within the groins survey area that was indicative of a possible shipwreck location (Figure 41). M1 is approximately 144 ft diameter, and is dipolar with a north-oriented negative pole and an amplitude of –45/+200 gammas. Though M1 is a relatively small amplitude anomaly, its characteristics are generally consistent with the anomalies of known shipwreck sites. Five inactive wells are also located within the project area; four of these wells are in a cluster northwest of the pier at the far eastern end of the Texas City Dike (see Figure 41). Anomaly M1 was recommended for avoidance during the proposed dredge material placement activities, by a minimum distance of 164 ft as stipulated by the THC State Marine Archeologist. If the area could not be avoided by the proposed activities, then diver ground-truthing of the anomaly was recommended (Borgens, Hudson et al. 2007).

Archival Research

During the Civil War the U.S. Navy purchased an assortment of New York area ferries, especially those owned and operated by Cornelius Vanderbilt for his Staten Island Line. Research conducted in Washington, D.C., and New York City sought to retrieve information not only on *Westfield*, but also on its builder, Jeremiah Simonson, and other ferryboats that were purchased and converted for naval service. These vessels include, but are not limited to the Staten Island ferries *Hunchback*, *Southfield*, *Westfield II*, *Clifton*, *Clifton II* (renamed *Shokokon*) and other ferries such as *John P. Jackson*, *Commodore Morris*, and *Commodore Perry*. Details regarding such topics as ship construction features, machinery, and shipbuilders for any of these types of vessels could further elucidate details about *Westfield*'s history. Below is a summary of the general materials located at each of the repositories visited. A summary of specific manuscripts and photographs duplicated during research is in Appendix A-5.

National Archives and Records Administration (NARA), Washington, D.C.: The research conducted at NARA, Washington, D.C., was focused primarily on determining details of *Westfield*'s construction characteristics or hull alterations following its acquisition by the U.S. Navy. Secondary objectives included determining previously unknown details of *Westfield*'s naval career, specifically surrounding *Westfield*'s service in and around Galveston in 1862 and 1863.

Paper records investigated were almost entirely from Record Group (RG) 45: U.S. Navy Subject File, 1775–1910. This is an extensive collection of miscellaneous subject matter relating to U.S. Navy vessels and operations. Within this record group, relevant documents consisted mostly of correspondence from George D. Morgan (the agent in charge of inspecting and purchasing New York–area merchant vessels for the Navy), and Charles W. Copeland (Principal [Steam] Engineer) to the Assistant Secretary of the Navy, Gustavus V. Fox, concerning the evaluation and eventual purchase of *Westfield* (as well as *Clifton, Southfield*, and *Jackson*) by the Navy. This correspondence

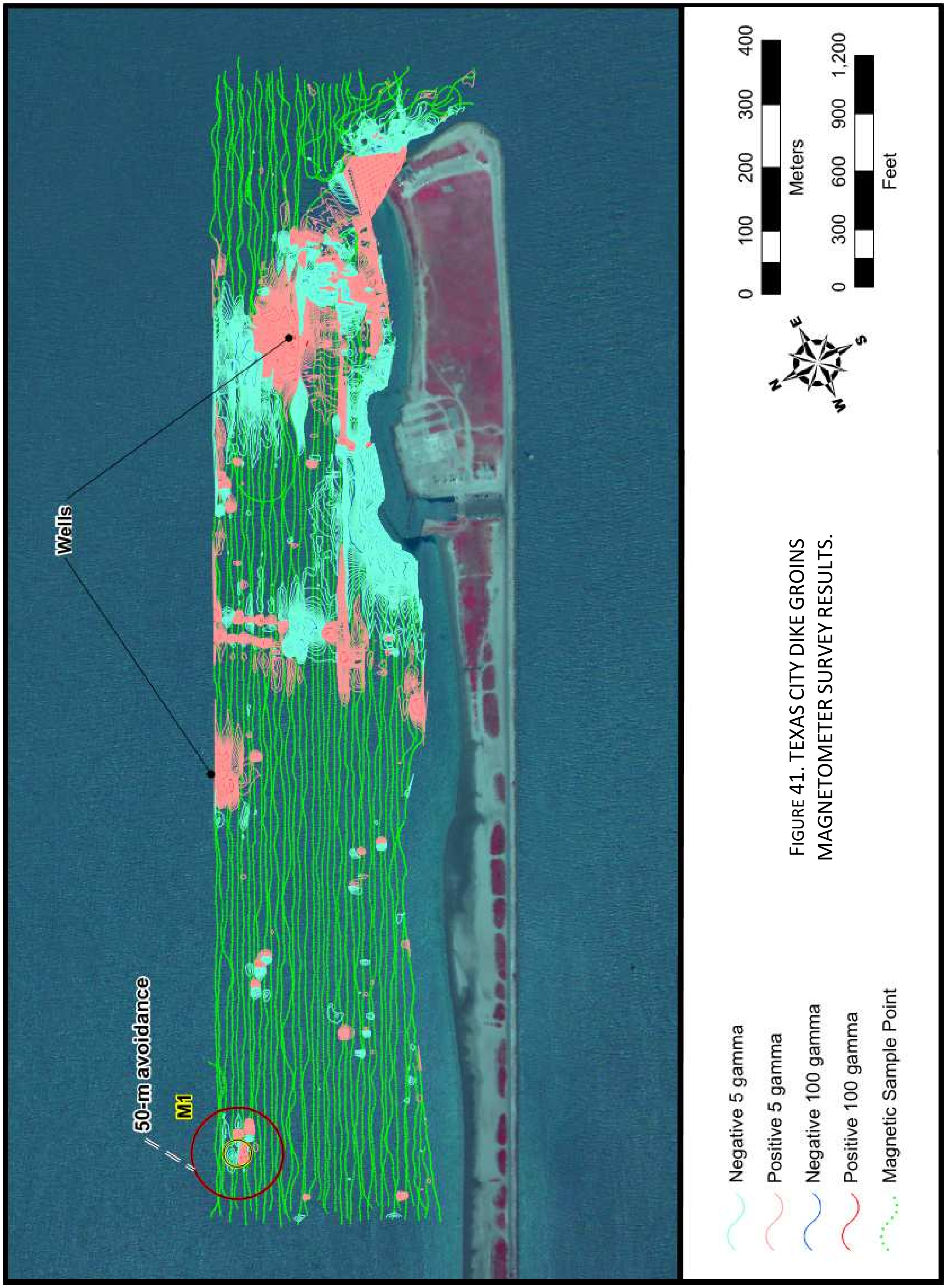

FIGURE 41. TEXAS CITY DIKE GROINS MAGNETOMETER SURVEY RESULTS.

included mostly discussions of purchase price, basic vessel characteristics as they relate to its suitability as a naval vessel, and allusions to necessary hull alterations. The bill of sale, vessel license, and enrollment are also included in this record group.

Similar correspondence exists in the microfilm collection, specifically in RG M124. This collection houses correspondence to the Secretary of the Navy, and is arranged chronologically. Correspondence between October and December 1861 (the dates covering the purchasing and hull refitting of *Westfield*) were investigated for any documentation relating to *Westfield*. Again, relevant letters existed between George Morgan, Charles Copeland, and the Secretary of the Navy's office concerning the inspection, purchase, and refitting of *Westfield*. Some of this correspondence was a reprint of correspondence located in RG45; however, most of it was unique. The most significant piece of documentation in this collection is a lengthy letter from Copeland describing in detail the alterations he recommended for converting *Westfield* into a gunboat.

Also in the microfilm collection, in RG M625, are correspondences to and from members of the Gulf Blockading Squadron, including *Westfield*'s Commanding Officer, Commodore Renshaw. This correspondence provides several interesting anecdotes about the U.S. Navy's activities in and around Galveston and the Western Gulf, both before and immediately after the Battle of Galveston. Included in this collection is a letter from Renshaw describing the initial capture of Galveston in October 1862, reports of blockade activity and confrontations with the enemy in Sabine Pass and Pass Cavallo, angry letters from Galveston citizens to U.S. officers, and officers' reports of the events of the Battle of Galveston.

National Archives and Records Administration (NARA), New York City: The National Archives in New York contains, among other items, legal cases, genealogical information, and port records for the State of New York. It also contains RG 181, the records for the New York Navy Yard. The records are arranged chronologically and separated by the Bureau of the recipient, the sender, or are inclusive of both groups. The collection of Navy records in RG 181 comprised dilapidated volumes of books, wherein most of the original letters were pasted on highly acidic degrading paper. The condition of the volumes, with one exception, did not allow for reproduction via Xerox. Almost all of the letters from the collection were digitally photographed without the use of a flash.

The largest assortment of letters from the archives was principally from the Bureau of Construction and Repair, RG 181, Entry (or series) 254. There were two boxes, containing three volumes, relevant to the focus years of the study (1861–1863). This was the most complete set of records of any bureau whose records were reviewed for the study period. This collection of letters discussed the building, repairing, conversion, and outfitting of naval vessels as well as boat supplies. These correspondences were written by John Lenthall, Chief of the Bureau for Construction and Repair, to Hiram Paulding, Commander of the New York Navy Yard. There were several navy bureaus whose letters were reviewed for the study. The following list summarizes the content of the collections:

- **Letters Sent to the Secretary of the Navy.** RG 181, Series 249. This series of letters principally covers allocation of officers and crews to boats, crew transfers, and review of boats, death of seamen, the status of hospitalized seamen, and movement of vessels to and from the shipyard. The general pattern dictates that once officers were assigned to a vessel, it was then ready to depart.
- **Letters Received from the Secretary of the Navy, November 1861–April 1862**, RG 181, Series 250. Letters from this collection detailed the assignment of officers to navy vessels, and details of ship equipment. Though a roster of the crew was not located, the assignment of crew by type, for both *Westfield* and *Clifton*, was discovered.
- **Letters and Telegrams sent to the Navy Department Bureaus, 1844–1865**, RG 181, Series 252. Series 252 is a collection of different types of letters sent to all the bureaus. These volumes appeared to contain letters that had not been included in their individual bureau's series. The contents within these volumes are organized by individual bureaus.
- **Letters Received from the Bureau of Equipment and Recruiting, 1862–1896**, RG 181, Series 256. This collection details the number and the type of personnel attached to the navy vessels and also discusses crew transfers.
- **Letters and Telegrams Received from the Bureau of Ordnance, 1845–1896**, RG 181, Series 265. Discusses gun carriages, ordnance equipped on vessels, and munitions. There are very few letters for the study period.
- **Letters Received from the Bureau of Steam Machinery, 1862–1896**, RG 181, Series 270. Dictates repairs to machinery as well as who was manufacturing it. Novelty Iron Works was used often. Unfortunately the New York Archives for the current study period starts at August 29, 1862. This collection discusses boilers, their testing, repair, and protection.
- **Letter and Telegrams Received from the Navy Agents and the New York Office of Supplies and Transportation Relating to Contracts for Supplies 1843–1865**, RG 181, Series 280. Only a few letters in this collection are from the months *Westfield* was at the New York Navy Yard, and none pertain to this vessel.
- **Letters Received from the Navy Constructor**, RG 181, Series 296. This series of letters discusses if naval vessels needed alterations, copper sheathing, or renovations. They alerted the other bureaus when the vessels were ready to receive officers. This collection ended in August 1861, two months prior to the research period. Benjamin F. Delano was the Chief Constructor.

The combined materials from NARA in both New York and Washington, D.C., created a detailed accounting of the purchase of the ferries in New York, their outfitting, construction, conversion, and crew assignments. Duplicates of some of the same letters were found in both collections. These letters specifically discuss *Westfield*, *Clifton*, and New York ferries built by Jeremiah Simonson and other New York shipyards. The accounts of the navy bureaus elucidate the intricate process involved in the purchase of pedestrian New York vessels and their conversion to naval craft. The undertaking of such work was organized and conducted at the New York Navy Yard, though this work was frequently subcontracted to prominent New York shipbuilders and machinists. Often these organizations were in competition for the same contracts and included such eminent professionals as Jeremiah Simonson, Jacob Westervelt, Copeland and Howe (operated by Charles W. Copeland, former constructing engineer to the U.S. Navy [*New York Times* 1895]), Morgan Iron

Works, and Novelty Iron Works. In many cases, a shipbuilder like Jacob Westervelt was hired to convert a vessel built by a competitive shipbuilding company such as the Simonson shipyard.

The letters from NARA in New York and Washington, D.C., discuss specific machinery and construction features that may assist in understanding the features of the archeological site. This is principally evident in the lists of characteristics required of several converted ferryboats, including *Westfield*, that were located at NARA in Washington, D.C. Other related documents include the conversion of a vessel into an iron-clad, and also discussion of the Normandy Patent condensers fitted to the naval vessels.

New York Historical Society: The Manuscript Library at the New York Historical Society (NYHS) contained the papers of Gustavas Vasa Fox, the Assistant Secretary of the Navy. This series of letters supplemented the NARA collection in the details of the purchase and conversion of the New York ferries. Also included within the Fox Papers is a detailed proposal for the construction of a double-ended ferrylike vessel, written in 1862, and comparisons of *Westfield* and *Clifton* to other converted New York ferries.

The NYHS also contained the complete collection of the New York City Directory of the study period. A perusal of the city directories demonstrated that the shipbuilding company Bishop and Simonson was first listed in the 1833 and 1834 edition. Jeremiah Simonson at that time was listed by his birth name, Cornelius Simonson. The company was comprised of Jeremiah, his father Charles M. Simonson (a shipjoiner) and Joseph Bishop. The company ceased being listed as Bishop and Simonson in 1848 and by the following year it was simply under Jeremiah Simonson's name. The last listing for the Simonson shipyard was in the 1867 and 1868 edition.

The Department of Prints, Photographs, and Architectural Collection at the NYHS contained several images of New York ferries built by Jeremiah Simonson for the Staten Island Ferry Co. Unfortunately the organization of the collection prevented the archivist from locating these photographs, though they were previously published in the book *The Staten Island Ferry* by George Hilton in 1964. Relevant photographs from the collection were xeroxed and are listed in Appendix A-5.

New York Public Library: Two branches of the New York Public Library (NYPL) were utilized for research: the Irma and Paul Milstein Division of United States History, Local History and Genealogy (NYPL Humanities Library) and the Science, Industry, and Business Library. These collections provided genealogical information on Cornelius Vanderbilt and Jeremiah Simonson and also data on the ferries *Clifton II* and *Southfield II*. Though death records could not be located for the shipbuilder Jeremiah Simonson, census records indicate he died between 1870 and 1880. The Division of Photography and Prints at the NYPL was consulted, though it was later discovered that the researcher was misdirected by an employee as to the nature of the collection. The researcher was informed that this division did not have relevant images, though ferry photographs from this collection were later located at the NYHS.

Staten Island Institute of Arts and Sciences: The Staten Island Institute's library provided photographs and stereographs of several of the Civil War–era ferries of Staten Island. An index of historic area newspapers on microfilm was helpful in obtaining copies of articles detailing the launch of *Westfield* and *Clifton* on the Staten Island Service (called the Railroad ferries) and the ferry schedule. The library's files on the vessels were copied, in addition to genealogical information on the Simonson family.

Several archives and collections in New York City could not be visited due to unforeseen circumstances or time constraints. The Staten Island Historical Society had an unscheduled closing during Atkins's visit. The extensive archive of the Herman Melville Library that is part of the South Street Seaport Museum was closed for 3 years due to reorganization and movement of the collection. This library contains source material on the New York–area shipbuilding industry. The Manuscript collection of the NYPL and the Museum of the City of New York could not be visited due to time constraints.

The materials located from the archive collections in Washington, D.C., and New York City create a detailed chronology of *Westfield* at New York City, from the time it was launched as a ferry, to its purchase by George Morgan, through its conversion by Jacob Westervelt. Bibliographical information regarding Simonson, Vanderbilt, and Westervelt was located at the archives, in addition to a wealth of information concerning organization processes regarding the ferryboats at the New York Navy Yard and aspects of their ship construction. Invaluable data regarding *Westfield* was collected during the research trips including a list of its gunboat features proposed by Copeland, the assignment of its conversion from Copeland (and Howe) to Westervelt, the description of some of its ferry construction features (iron-braced with iron paddlewheels), its number and type of crew (130), and the assignment of several of its named officers.

Summary of Results

The results of the research conducted in Washington, D.C., and New York added significantly to the current understanding of the conversion and naval career of *Westfield*. The details regarding specific construction features and machinery on ferry gunboats aided development of research questions (see Chapter 5) for the mitigation plan. The investigations, however, did not locate specific images or plans for other vessels of this type, though photographs of similar Staten Island ferries were found. Further research specifically focused on locating ship plans would be beneficial to the mitigation effort since preserved hull remains appear to be absent. At the conclusion of the project Atkins recommended research at the Mariner's Museum (Newport News, Virginia) and Rosenberg Library (Galveston, Texas) for possible images or manuscript material that may pertain to *Westfield*'s career and demise in Galveston. Since this archival research was conducted, the

Mariner's Museum was consulted for potential materials, without success, and the collection at Rosenberg was searched for historic documents (at no additional expense to the USACE). In addition, Ed Cotham Jr., author of *Battle on the Bay: The Civil War Struggle for Galveston*, *Sabine Pass*, *the Confederacy's Thermopylae*, and *The Southern Journey of a Civil War Marine*, the *Illustrated Note-Book of Henry O. Gusley*, donated personal research pertaining to *Westfield* that was identified developing these manuscripts. This documentation included research conducted at Rosenberg Library and the Center for American History (Austin, Texas) and included copies of the original Confederate Prize Commission proceedings that are transcribed and included as Appendix A-2. Information collected from these respective archival sources has been integrated into chapters 2 and 6)

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5

RESEARCH TOPICS

The historic significance of USS *Westfield* was well established by investigations preceding its 2009 archeological recovery and can hardly be overstated. It is an example of a rare type of naval vessel about which little is known and of which few archeological examples are documented, and it is the only land or marine archeological site yet investigated from the 1863 Battle of Galveston. *Westfield* was constructed as a ferry and converted to a gunboat by preeminent New York shipbuilders. It was owned by Cornelius Vanderbilt during its early commercial use. It is associated with significant battles of the Civil War and with the Staten Island Ferry, an American institution that evolved from a Vanderbilt-run ferry service begun in 1817. Very few archeological examples of Civil War–era ferry-gunboats are known. Finally, the grounding of *Westfield* was pivotal to the retaking of Galveston by Confederate forces.

No assumptions could be made, prior to recovery, conservation and analyses of the artifact assemblage, regarding what might be learned from these investigations, despite *Westfield's* obvious importance. The site, after all, appeared from preliminary dive investigations to consist of a mostly disarticulated scatter of artifacts on the seafloor with very little depositional depth and no hull remains. The very nature of the site, combined with the fact that so few examples of this type of ship had been archeologically documented, led investigators naturally to wonder most about aspects of the site that were least known, and quite possibly least knowable. Most questions related to one or more of only a few general topics. Those five research topics form the organizational framework for describing and discussing the results of archeological recovery in subsequent chapters of this report. They include the following: 1) details of *Westfield's* construction, both as a Staten Island Ferry and as converted and outfitted for naval duty; 2) corroboration of historical accounts of the ship's use and loss; 3) effects of destruction, salvage, demolition and erosion; 4) insight into sailor's lives based on personal effects and other objects; and 5) evidence regarding horizontal integrity of artifact distributions.

Investigators understood that these research topics would be addressed with varying degrees of success based on the artifact assemblage alone. For example, without hull remains, there were obvious limitations as to what could be learned about the ship's construction based on the archeology. Likewise it might be difficult to distinguish evidence of the ship's original destruction from later demolition, since both involved explosions. It was clearly understood that interpretation of the archeology must rely upon other evidence and reasoning at every opportunity; therefore, the following discussion of each topic summarizes other available resources, both archival and archeological, that might aid in this and future analyses.

SHIP CONSTRUCTION, CONVERSION AND OUTFITTING

Preliminary mapping and probing of the site in June 2006 demonstrated that artifacts were limited to a very thin zone of sediment overlying a hard layer of culturally sterile marine clay. It was clear following those investigations that little or no direct evidence of hull construction would be forthcoming. In order to address questions of construction, it was necessary to work backwards using construction details from analogous vessels. This required making some assumptions concerning the similarity between *Westfield* and its closest contemporaries. However as the likely hull plan for *Westfield* took shape from other documentary evidence, the result became a useful tool for inferring specific artifact placements within the ship, as well as for recognizing substantial movement of artifacts from their most likely original positions.

There are very few photographic or graphic representations specifically of Staten Island ferry-gunboats in the archival record and original construction plans have not been discovered for *Westfield* or for any similar Staten Island ferries. A sketch made of *Westfield* in December 1862 (Figure 3) is, so far, the only identified scale drawing of the steamer rendered by an eyewitness of the vessel. The attention to small details in Figure 3 instills confidence in its overall accuracy. *Westfield's* original design can be surmised from plans produced by William Cowles based on his personal measurements of another Staten Island Ferry, *Southfield II*, after it was built (Figure 42). *Southfield II* was completed in 1882, but the Staten Island Ferry design had not changed substantially since before *Westfield* was built. Cowles stated that "…our ferryboats remain today practically the same as they were thirty years ago…" (Cowles 1886:191). Based on Cowles drawings and his observation that ferryboat design was fairly static during this period, his *Southfield II* plans were used as the starting basis for reconstructing *Westfield*'s hull. *Westfield's* actual design likely differed only slightly from *Southfield II.* Reconstructed plans for *Westfield* (Chapter 8) were modified where necessary to be consistent with measurements of artifacts from *Westfield*. The *Southfield II*'s design, once modified to reflect *Westfield*, provided a thorough understanding of the ship's likely internal layout. The resulting hull plan, combined with details from the Memphis Library drawing of *Westfield* in Figure 3, was used by archeologists as the basis for interpreting the distribution of artifacts.

A small number of archeological analogues exist, which have potential to shed light on the design and military conversion of *Westfield.* Almost two dozen sidewheel ferries were purchased and converted for military use by the U.S. government during the Civil War. Five of those ferries, *Hunchback, Clifton, Clifton II* (renamed *Shokokon*), *Southfield*, and *Westfield*, were of Cornelius Vanderbilt's Staten Island & New York Ferry Company. *Westfield* was one of seven ferry boats built by prolific Greenpoint and Brooklyn shipbuilder Jeremiah Simonson. Four of Simonson's ferries were converted to naval gunboats: *Hunchback, Clifton, Shokokon*, and *Westfield.* Three of the Staten Island ferry gunboats were lost in naval engagements: USS *Westfield* and USS *Clifton* were both lost in separate naval conflicts on the Texas coast in 1863 and 1864, and *Southfield* was sunk by the CSS *Albemarle* in North Carolina in 1864 (Cotham 1998, 2004; Spirek 1993). USS *Hunchback* returned to ferry service following the war but was later decommissioned and scrapped. USS *Shokokon* was auctioned, used as a merchant steamer, and rechristened *Lone Star*. It disappears from the vessel registers in 1886 (Silverstone 2001:71).

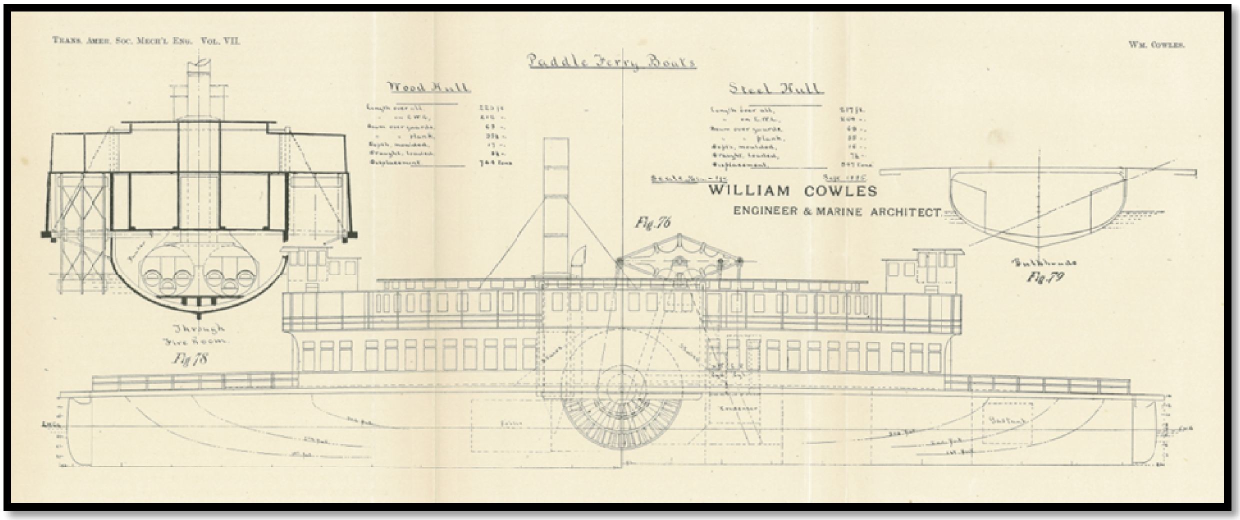

FIGURE 42. SIDEWHEEL STEAM FERRY PLANS BASED ON MEASUREMENTS OF *SOUTHFIELD II* (COWLES 1886)

The wrecks of both USS *Clifton* (Figure 43) and USS *Southfield* have been the focus of archeological assessment. The wreck of *Clifton*, Site 41JF65, was still partially visible in the early 1930s. Metallurgists from The Texas Company (Texaco) analyzed the iron content of samples extracted from its stack, steam chamber, and anchor winch in 1934. An undated photograph from their study showed upwards of 8–12 ft of the steam stack exposed above the waterline (Wilten and Dixon 1935). The now-buried wreck was relocated during an archeological remote-sensing investigation of Sabine Pass Channel in 1994. In addition to a remote-sensing survey, a portion of the 1994 study was focused on locating and assessing the current condition of the wreck and to determine future impacts to the historic site caused by jetty maintenance and repair. Probing of the wreck of USS *Clifton* indicated that substantial portions were extant but buried under mud and marsh grass. The walking beam was removed in 1911 during early jetty work at Sabine Pass (Hoyt et al. 1994:55). Archeological work has not been conducted on *Clifton* since the conclusion of the 1994 investigation.

USS *Southfield* was discovered in 1990 by Tidewater Atlantic Research during a remote-sensing survey in the Roanoke River near Plymouth, North Carolina (Spirek 1993:108). The steamboat was subsequently the focus of an archeological field school conducted by East Carolina University in 1991. Divers mapped a 75–80-ft unburied portion of the wreck, which included the gundeck of one end (believed to be the aft end) of the ferry (Figure 44). The southern portion of the wreck and the upper superstructure were destroyed during the 1870s when part of the vessel was "cleared" from the river. A few artifacts were recovered and documented during mapping of the site. Their documentation of *Southfield* provides the most comprehensive archeological assessment of a Staten Island ferry-gunboat to date.

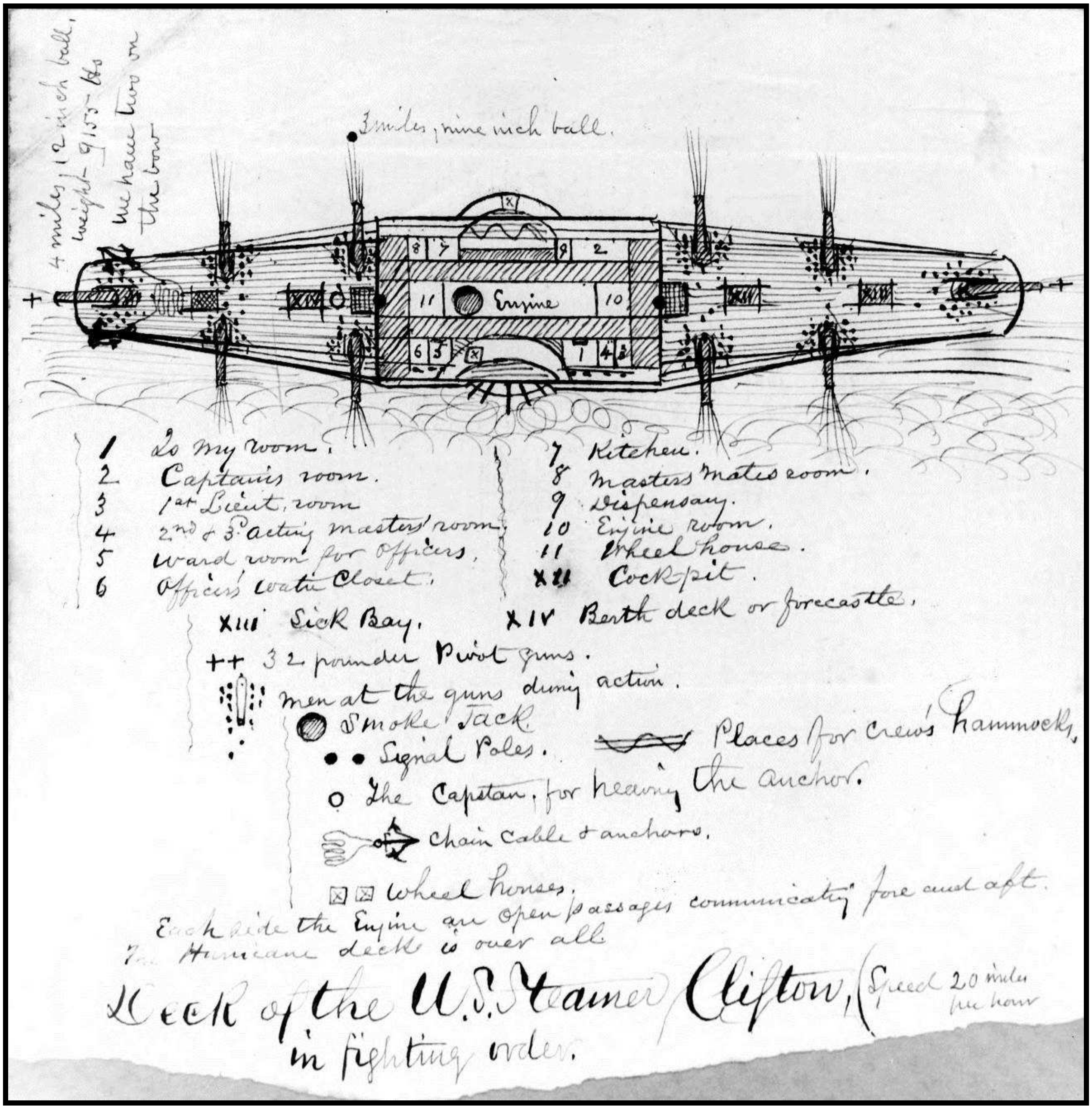

FIGURE 43. DECK OF USS *CLIFTON* IN FIGHTING ORDER (SKETCH 75 BY DR. DANIEL NESTELL. COURTESY OF THE NESTELL COLLECTION, NIMITZ LIBRARY, U.S. NAVAL ACADEMY, ANNAPOLIS, MARYLAND)

The Simonson-built Staten Island ferry *Westfield II* (Figure 2b) was still in service into the early 1900s, even after the explosion of its boiler in 1871. That event is still considered the worst disaster in the history of the ferry service, and yet in spite of the catastrophe, at the time of its retirement in 1905 it held the record for the longest tenure of service in the fleet at 44 years (Scull 1982:10). The remnants of two wrecked ferryboats near that of *Astoria* in New York Harbor are believed to be *Westfield II* and *Middleton.* The wreck of *Westfield II* (Figure 45), known as vessel no. 58, was

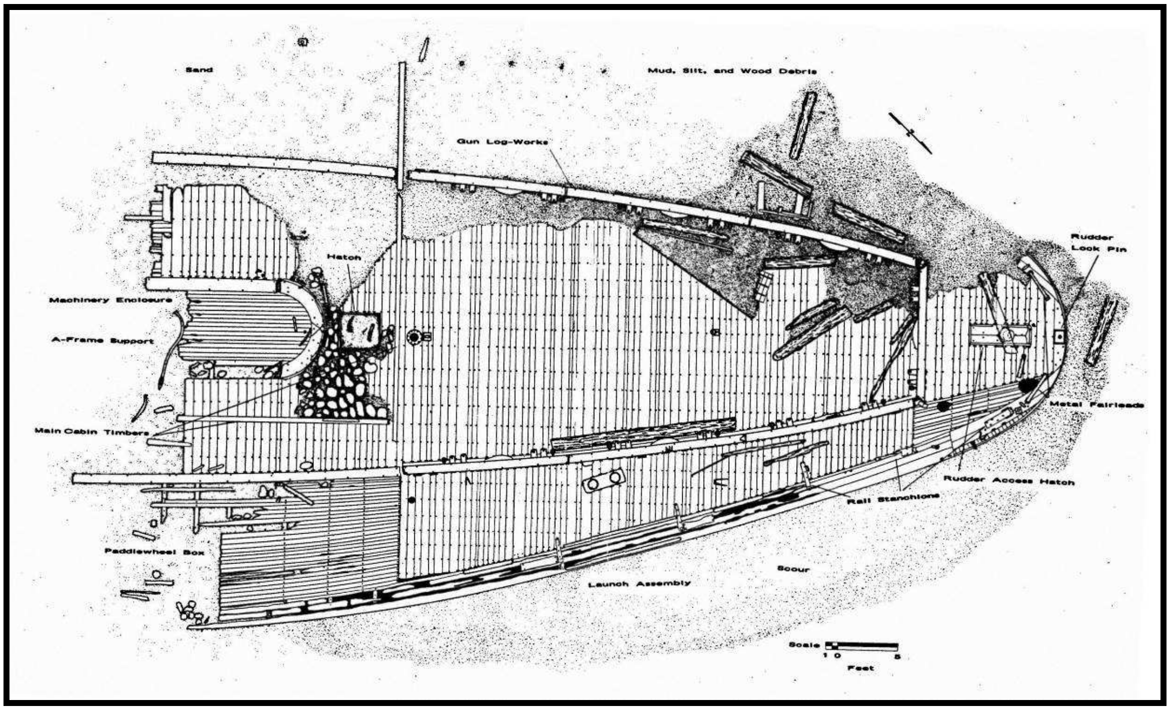

FIGURE 44. *SOUTHFIELD* SITE PLAN (SPIREK 1993:120)

FIGURE 45. *WESTFIELD II* (JAMES ET AL. 1999)

examined by Panamerican Consultants in the late 1990s. The lower hull of the ferry, consisting of frame pairs, sister keelsons, engine bed timbers, veiling, and hull planking, was in excellent condition and was almost completely accessible at low tide (James 1999:76). Though this wreck was originally earmarked as the topic of an East Carolina University thesis (Spirek 1993), the site has not been the focus of detailed archeological investigation. Archival research conducted for the current project has elucidated details concerning the review, purchase, outfitting, and crew assignments on many of the ferries acquired by the U.S. Navy, including *Westfield* (see Chapter 2). Paperwork pertaining to the outfitting of items such as gun carriages was discovered for other newly purchased vessels, but very little data of this nature were located specifically for *Westfield*. Incidentally, several paper collections at the New York Branch of the National Archives did not include the months *Westfield* was purchased and outfitted. Those paper collections include Letters Received from the Bureau of Construction and Repair (building, repairing, and outfitting of naval vessels); Letters Received from the Bureau of Equipment and Recruiting (number and type of crew assigned to vessels and crew transfers); Letters Received from the Bureau of Steam Machinery (repair, testing, and manufacturer of steam machinery); and Letters and Telegrams Received from the Navy Agents and New York Office of Supplies and Transportation Relating to Contracts for Supplies. Due to the loss of important early archival data, much of what has been learned regarding *Westfield*'s appearance and how the steamer was converted and equipped is circumstantial.

CORROBORATION OF HISTORICAL ACCOUNTS

Historical accounts of *Westfield* include documents and drawings related to its life as a Staten Island Ferry, to its career in the Union Navy, and to its loss in the Battle of Galveston. The stories told by the artifacts regarding historical events might offer some new insights to clarify contradictory accounts. However, even were no novel revelations to be gained, the very ability to pick up an artifact and recognize a connection with a particular moment in time is exciting.

One example of a small but interesting connection between artifacts and history concerns *Westfield's* role in the steamer division of Commodore Porter's Mortar Flotilla. *Westfield* played a significant part in the mortar shelling of Confederate forts at New Orleans and Vicksburg. The steamer division was eventually separated from the Mortar Flotilla, and *Westfield* was reassigned as the flagship of the West Gulf Blockading Squadron tasked with capturing and holding the Texas port of Galveston (Cotham 2006:25). The battles at New Orleans and Vicksburg are well-documented in historical accounts. *Westfield's* involvement in those conflicts was important but relatively unremarkable compared with the overall scope of operations. Yet the recovery of a single 13-inch mortar shot from *Westfield* in 2009 established a tangible connection between this shipwreck in Galveston Bay and two strategic battles for control of the Lower Mississippi River.

Many other links exist between specific *Westfield* artifacts or groups of artifacts and historical records. A few examples are summarized here to illustrate the variety of connections possible. The size of boilerplates used for armoring the ship was a perfect match for those drawn to scale on the Memphis Library illustration of *Westfield* (Figure 3). The placement of the recovered Dahlgren cannon matches an eyewitness account from the week leading up to *Westfield's* destruction. Artifact distributions verify historic accounts of the bow separating from the ship as a result of the forward magazine explosion. Positions of the firebox and Dahlgren, two artifacts presumed to lie very close to their original positions, allow a close approximation of the ship's heading when it ran aground, in agreement with an eyewitness drawing of the ship aground and one Confederate salvers report (Appendix A-2, Letter 7). Evidence from boiler fragments seems to confirm a boiler explosion as perhaps implied by Scharf (1887:508), although the timing of their destruction remains in question. Major Burt stated that the guns were run out and double shotted when the ship was destroyed (Burt 1863). Perhaps some guns were double shotted in preparation for close-quarters battle; however, the recovered Dahlgren contained only a single shell (one of many examples where artifacts have helped clarify misconceptions, errors or contradictions in historical accounts).

Interesting historical connections are not necessarily dependent on physical artifacts. One fascinating story is worth repeating in which a historic drawing became the artifact. The Memphis Library drawing of *Westfield* (Figure 3) shows a cannon on the hurricane deck facing the bow. A diary entry by a marine stationed on *Westfield* (Cotham 2006) confirmed this was a Quaker gun, a fake cannon carved from a log and painted black, which had been captured from Pelican Spit when the Union fleet arrived at Galveston. The independent corroboration of this strange, small detail from the only known eyewitness drawing of *Westfield* provides an added sense of confidence in the drawing's overall accuracy. The artist clearly drew what he saw.

EFFECTS OF DESTRUCTION, SALVAGE, DEMOLITION AND EROSION

Much of *Westfield's* identity as an archeological site was affected by its destruction during the Battle of Galveston, its salvage by the Confederacy, and its demolition as an obstruction to navigation. As if these manmade disturbances were not sufficient, the sediment beneath the site steadily eroded over the decades until the stern area where the ship had run aground in 7 ft of water was 46 ft deep in 2009. Early impressions of the site were of a disarticulated scatter of artifacts on the seafloor with very little depositional depth and no hull remains. A brief synopsis of the many site disturbances follows.

Explosion of the forward magazine reportedly split the ship into two pieces, separating the bow from the rest of the vessel. The testimony of a Confederate diver involved in the salvage stated that he ". . . found the wreck to consist of about one half of the hull of the vessel embedded in the sand and in about six feet of water—The decks were burned off of her forward [*sic*, aft] and the stern [*sic*, bow] part blown off about sixty yards . . ." (Appendix A-2, Letter 7). One or both boilers might have explosed simultaneously with the detonation of the magazine, after which fire consumed the vessel to the waterline.

Salvage work was begun almost immediately by the Confederates. Early work at the vessel included the removal of the iron and copper from her upper works, two guns, and the steam stack. The 13-inch-diameter wrought-iron paddlewheel shafts of *Westfield* were raised and bored out to make guns. Salvage in May 1863 was conducted by divers. An extensive list of objects recovered from *Westfield* by divers included intact perishable materials (Confederate Prize Commission Records 1863). Five barrels of meat, a barrel of beans, and six coils of rope were among the items brought up from the aft hold, negating the possibility that both magazines exploded and corroborating a report by Abbott (1866:456) specifically stating that the aft magazine did not detonate. The preservation of such materials indicates the stern must have been relatively undamaged below the waterline.

At the time of the wreck event, one end of the ship was reportedly grounded in 7 ft of water. The tops of the boiler drums would have been 6 ft above the water when the ship first ran aground. Over time *Westfield* sank deeper. The boilers remained visible for 23 years following the wreck event, before reportedly sinking in 1886 during a hurricane that submerged Galveston Island (Ziegler 1938:240). By 1906 the top of the boiler drums were about 18 ft underwater (*Galveston Daily News* 1906) and the surrounding seafloor was at least 30 ft deep (USACE 1905). Remaining wreckage of the boilers and engine were brought up by a combination of dynamiting and lifting in 1906. The explosives were placed by a diver and detonated remotely with electric wires from the snag boat *General. S.M. Mansfield* (*Galveston Daily News* 1906). Following demolition of the site, sediment continued to steadily erode from beneath the remaining wreckage until the area reached its 2009 depth of 46 ft.

Westfield experienced substantial disturbances of many types. It is not surprising that investigators' early assumptions regarding site integrity were pessimistic. One of the biggest unknowns prior to archeological recovery was whether anything could be learned from a site where so much damage had occurred. Understanding the extent and effects of site disturbances was considered essential to interpreting artifact distributions and how they reflect upon the site's horizontal integrity.

Researchers focused simultaneously on diverse lines of evidence to build understanding of how each disruptive action might have affected the site's integrity. Accounts of the ship's destruction, salvage and demolition were examined for chronological evidence documenting the ship's deterioration. Historic records, largely cartographic, were used to document changes in water depth over the site. Reconstruction of *Westfield's* hull plan, when compared with water depths reported in 1906, demonstrated the likely condition of the site prior to demolition. The design of the snag boat *General S.M. Mansfield,* when viewed in light of working limitations imposed by tidal currents over the site, provided insight as to how the boilers might have been removed, which is consistent with the distribution of boiler-related artifacts on the seafloor.

Direct evidence from artifacts might also have explanatory power. For example, the presence of large numbers of hull fasteners, including sheathing tacks, would suggest that the hull slowly deteriorated in place. While the hull was even partially intact, its presence would have provided artifacts inside with protection from lateral displacement by currents and might also have promoted prolonged burial of artifacts. Abundant survival of artifacts as small and light-weight as sheathing tacks also might suggest that fewer artifacts have been removed by extreme storm tides than originally feared.

Despite extensive disturbance of the site, much valuable information remains to shed light on other research topics. Reconstructing the chronology of the ship's destruction and deterioration from 1863 to 2009 would be helpful to interpreting the site as a whole, but undoubtedly will remain incomplete and somewhat speculative. Nevertheless, the contents of a wrecked ship, even when widely dispersed across the seafloor, are representative of a single moment in time. The substantial destruction and movement of artifacts from their original positions on the ship does not completely erase the potential to discern their original forms and functions.

SHIPBOARD LIFE

The Civil War was largely a "soldier's war" with scant attention paid to the plight of the northern sailors who crewed the gunboats, ships, and monitors that were so often isolated from the major theaters of war. Over 2 million men served as soldiers in the U.S. Army during the Civil War. By comparison, only 118,044 men enlisted in the Union Navy. Little scholarship has focused on these sailors, and recent publications continue to perpetuate false mythologies of Civil War naval service (Bennett 2004: x, 211). The Union sailor during the Civil War was of a much different character, both socioeconomically and ethnically, than the Union soldier. New naval recruits were largely from poor working-class environments, were foreign born or former slaves, unlike Union soldiers who more often hailed from rural towns and farms (Bennett 2004:6–7). Approximately 45 percent of Union sailors were immigrants, and an estimated 15 to 20 percent of the Union Navy were either enlisted or informally inducted African Americans termed "contrabands" (Bennett 2004:10–12).

Daily life on a Union naval vessel was characterized by monotonous, laborious work often without "liberty" or shore leave. Blockading vessels were seldom farther than 6 to 9 miles from shore and could work in the same area for extended periods without traveling. Yet fear of desertion prompted naval officers to avoid landing sailors for the entirety of their cruise. Tenure of service on a Union blockading vessel like USS *Westfield* was longer than that of an ordinary service vessel and could last from 6 to 18 months. The blockade sailor might work the cycle of an entire day given that blockade-runners frequently operated in the dark of night or at the break of dawn. It was an environment bereft of ample leisure time, wherein pencils, stationery, and even religious solace were considered a luxury (Bennett 2004:55–58, 66, 149–150).

Preliminary archeological dives in 2005, 2006 and 2009 discovered a relatively small number of artifacts of a more personal nature than the larger fragments of mostly iron that dominated the visible debris field. A historic ginger bottle and sherds of glass were observed in 2006. A complete, intrusive historic Billy Baxter ginger ale bottle (circa 1920) also was discovered, suggesting other fragile, light-weight artifacts may have survived. A Union belt buckle was recovered during fieldwork in May 2009 (Figure 46).

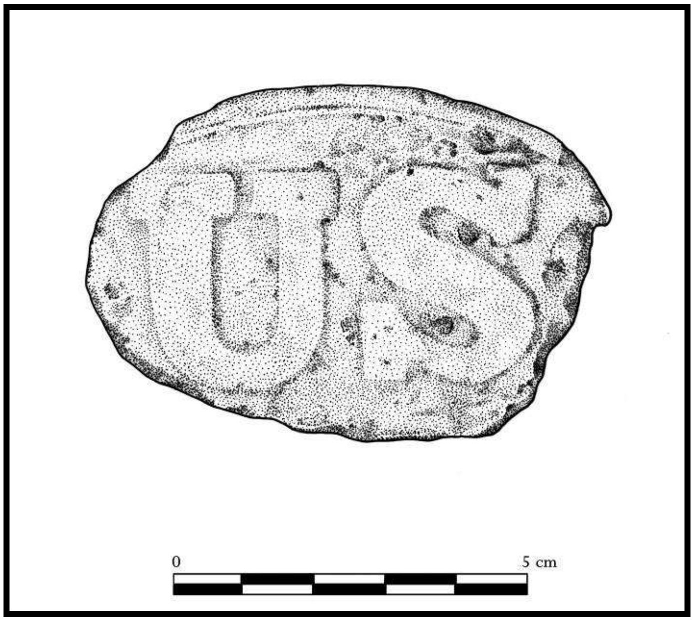

Figure 46. Union Belt Buckle
(Illustration by A. Borgens 2009)

Expectations were low for learning much about shipboard life due to the extensive disturbances of the site that were known to have occurred. The few small artifacts observed in preliminary dives were attributed to scour pockets and recesses around larger artifacts, where they might have been protected from high currents, and might not have been indicative of the entire site. Nevertheless, all sediment removed from the site during archeological recovery was screened through ¼-inch mesh. Filter boxes used for collection of sediment on board the materials barge had ¼-inch mesh bottoms and 1-inch mesh sides. Care was taken not to overload those boxes so that sediment did not wash through the larger mesh lining their sides. Archeologists completed detailed screening on shore using ¼-inch mesh as the smallest size in hopes of maximizing the amount of small artifacts recovered.

Little is known of *Westfield*'s crew. A roster of its enlisted sailors has not been discovered. The diary of Henry O. Gusley, a marine stationed on the ship for its entire career, describes *Westfield*'s military actions and his personal observations of places they visited, but he rarely talked about daily activities of the crew or details of shipboard life (Cotham 2006). The discovery of small, fragile, unique, or personal items would help fill gaps in our knowledge of daily life onboard *Westfield* and would have importance on several levels. Any insights into naval life gleaned from *Westfield's* artifacts certainly would be of interest to Civil War scholars. And the survivability of such materials, seemingly the least likely to be preserved in such a dynamic situation, would demonstrate the importance of maintaining high archeological standards even in the face of low expectations. Finally, the discovery of any artifact that was held in the hands of a *Westfield* crewmember and used to perform a specific function could bring the ship's story to life in a way that a piece of the engine cylinder, for example, could not. Investigators speculated, when the first belt buckle was discovered, whether it had been worn by one of the men who died when the magazine exploded. Of course this is unknowable, yet it is not impossible. Human connections to historical events are extremely important to telling stories of those happenings.

HORIZONTAL INTEGRITY

Questions of integrity were a topic of discussion among investigating archeologists from the moment rediscovery of *Westfield* was confirmed. Historic accounts of the ship's violent destruction, salvage, and demolition, combined with the fact that it was located in a federally maintained ship channel, were cause for concern regarding the level of preservation to be expected. One of the earliest tasks conducted on the site, in 2006, was to map the horizontal and vertical extents of the site. It was determined from that effort that the site was a disarticulated artifact debris field, limited to a thin layer of weakly consolidated sediment, overlying a sterile marine clay deposit, and without evidence of hull remains. On the positive side, it was learned that the site had not been dredged. Nevertheless water depths had increased through erosion from 7 ft on the bar where *Westfield* ran aground in 1863 to 46 ft across the entire site by 2005. Given the magnitude of known site disturbances, it was natural to wonder whether the relative positions of artifacts had been preserved. It was clear that the site could not retain meaningful vertical stratigraphy; however, reports from other heavily disturbed shipwrecks suggested there might be a chance for some integrity of artifact position in the horizontal dimension.

Several other shipwrecks have been documented that demonstrate horizontal integrity despite significant increases in water depth between the time of the wreck event and the time of archeological investigation. In each of four cases, *Queen Anne's Revenge* (1718), *Nuevo Constante* (1766), *Isabella* (1830), and SS *Mary* (1876), archeologists have shown that wrecks in high-energy erosional environments can retain horizontal integrity despite depth increases of up to 30 ft and, in some cases, even when affected by dredging.

The British brig *Isabella* ran aground on a sand bar at the mouth of the Columbia River in 1830. This NRHP-eligible wreck experienced almost 40 ft of vertical migration similar to that of *Westfield*. The wreck was discovered in 1986 and was mapped by archeologists from the National Park Service. Divers recorded a section of articulated wooden hull measuring 80 ft long by 25 ft wide (Delgado 1997:207).

SS *Mary* was a 234-ft Morgan Line sidewheel steamer that ran aground on the outer bar and sank in 1876 while attempting to navigate Aransas Pass, Texas, in poor weather (Pearson and Simmons 1995:101). The post-depositional history of this wreck bears some similarities to that of *Westfield*. Both vessels are sidewheel steamers with walking beam engines, and they are of similar size (SS *Mary*, 234.2 x 32.8 x 9.3 ft vs. *Westfield*, 213.3 ft LWL x 34 ft breadth of beam x 12.9 ft depth of hold). Both vessels lie alongside or within ship channels and have been impacted by attempts to clear them as obstructions. And lastly, both sites are widely scattered debris fields of similar scale. The intact 34-ft section of the bow of SS *Mary* lies within an artifact debris field measuring 175 x 100 ft and excludes a 50-ft section of the stern that has been destroyed due to previous channel work (Pearson and Simmons 1995:112). The visible debris field for *Westfield,* by comparison, was slightly smaller at 164 x 84 ft. The extant hull of SS *Mary*, which is iron, is heavily eroded, discontinuous, and only preserved to a 10-ft relief in a small area. The central portion of SS *Mary* was characterized by large pieces of machinery identified as two wrought-iron paddlewheel shafts, the walking beam, and surface condenser (Figure 47). Though the wreck has settled 30 ft since grounding in 1876, the large components have retained the same spatial relationship to the bow, and to each other, despite the change in vertical position and having been dynamited as an obstruction (Pearson and Simmons 1995:112–113). Documentation of SS *Mary* did not include extensive artifact recovery; only seven artifacts or artifact concretions were collected. These were largely comprised of copper pipes, tubing, and plates, though one concretion did contain complete cartridges, shell casings, lead bullets, and brass screws (Pearson and Simmons 1995:124).

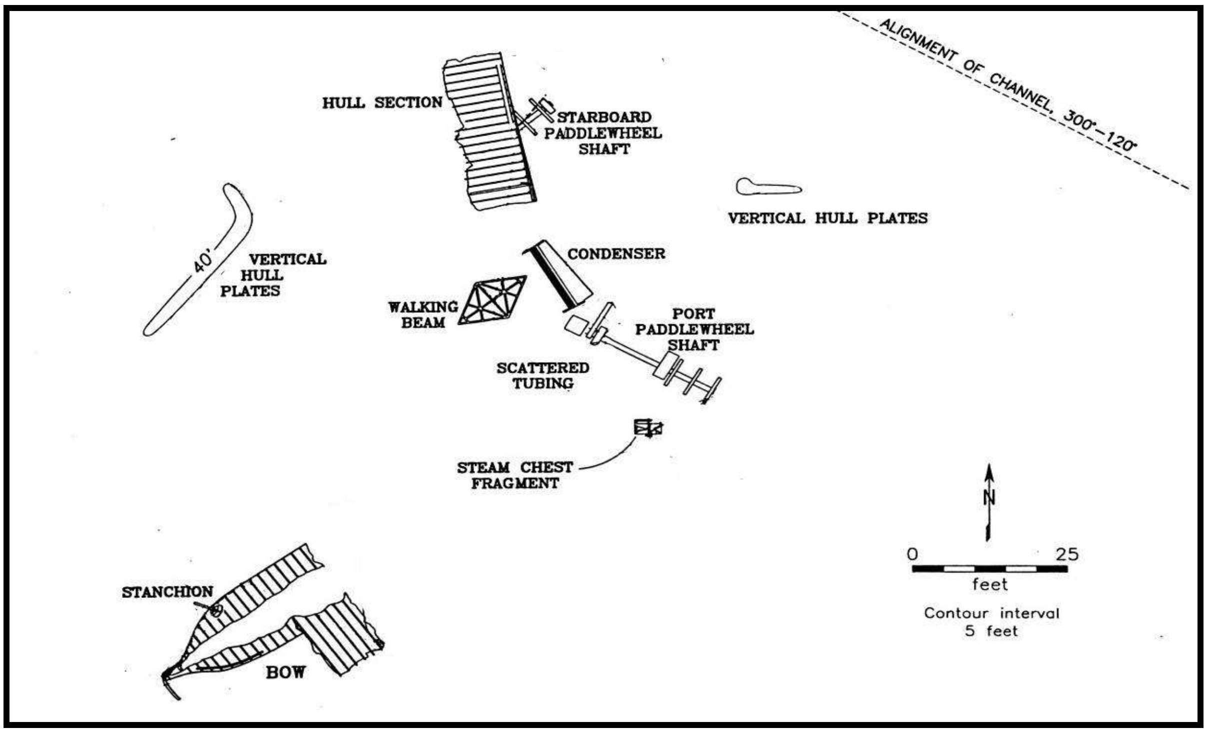

FIGURE 47. SITE OF SS *MARY* (MODIFIED FROM PEARSON AND SIMMONS 1995:115)

El Nuevo Constante grounded off the coast of Louisiana during a storm in 1766 and like *Westfield* was salvaged at the time of its loss. Since the wreck event, the 1766 shoreline has migrated 4,580 ft inland from its historic location, and the wreck itself lies at a depth of –19 ft (Pearson 1981:12; Pearson and Hoffman 1995:102). When the wreck was discovered, the 125-ft lower hull had settled 10 to 15 ft deeper than its original deposition in 1766 and was completely intact. Coring at the wreck site demonstrated that *El Nuevo Constante* had settled into and had been covered by recent marine deposition consisting of clays and silty clay deposits.

The horizontal integrity of the site was agitated less by environmental factors than by modern manmade causes. The wreck was rediscovered by a shrimper in 1979 and portions were bucket dredged prior to the salver's recognition that the wreck was in state waters and therefore protected (Pearson and Hoffman 1995:5). The bulk of what was initially recovered through dredging was wooden hull structure (planking and frames) in addition to two anchors, copper, gold and silver ingots, ship fittings, leather, and an iron cannon (Pearson and Hoffman 1995:98). Despite vertical migration of 10-15 ft and disturbance of the wreck by modern salvers, the site retained significant horizontal integrity. Hundreds of artifacts were recovered during excavations at the site in 1980 and 1981. Artifact distribution of ceramic items (cooking wares and oil jar fragments), for example, was used to corroborate the organization of the vessel with historically recognized locations such as the galley (bow) and storage areas (central and towards the bow) on the vessel (Pearson and Hoffman 1995:177).

Archeological investigations at site 31CR314 in North Carolina, believed to be the *Queen Anne's Revenge*, have incorporated modern geomorphological research as a means to understand the environmental effects of scouring, currents, and shoreline migration on a historic shipwreck site (McNinch et al. 2006). *Queen Anne's Revenge* ran aground in shallow water (~10–13 ft) in 1718 while attempting to enter Beaufort Inlet. Assessment of the 164-x-82-ft wreck site in 1997 and 1998 found the shipwreck had migrated downward to a depth of 23 ft. Evidence from artifacts cast off during grounding or that spilled from the hull suggests the wreck has remained in the same position since the wreck event. In addition, all the artifacts appeared to rest on the same depth horizon, 20 inches below the seabed. The remarkable preservation of the lower hull timbers and young encrusting coral growth also indicated that the vertical trajectory of the wreck was accomplished through intervening cycles of scouring and reburial of the wreck (McNinch et al. 2006:291). Researchers postulated that the cycles of scouring and reburial had recently exposed *Queen Anne's Revenge.* The wreck had reached a depth in which lower wave action and the more cohesive underlying sediment limited continued scour and inhibited complete reburial. Despite vertical migration and cycles of exposure, lower hull was well preserved, which in turn promoted the horizontal integrity of artifacts.

One key difference exists between *Westfield* and the four examples cited above. Intact hull remains were preserved at all four of those sites, sheltering artifacts from wave and current energy while also preserving information about what portion of each ship artifacts were associated with. *Westfield* experienced similar erosional processes, but the site did not have any hull preservation when rediscovered. Erosion caused by ship wakes, tropical storms and hurricanes, winter storms, and tidal currents has deflated the *Westfield* site almost 40 ft, removing the original sedimentary context. Once the protective shell of its hull disappeared, perishable artifacts buried within may have disintegrated or washed away quickly. Examination of the artifact assemblage from *Westfield* will determine whether horizontal integrity can remain on a site that outwardly resembles a disarticulated debris field, is devoid of wooden hull remains, and has been subjected to extreme manmade and environmental processes.

Preliminary examination of the site in 2006 demonstrated that some artifact groups might retain horizontal integrity. For example, a tight grouping of six boiler mounts was observed within a 10-ft radius. These are believed to have remained virtually unmoved since 1906 when the boiler resting on them would have been removed from the site. Since that time, the site has migrated downward another 16 ft. A number of small light-weight artifacts such as historic ceramic and glass sherds that could easily be transported off-site by the strong tidal currents also were observed in 2006. The discovery of these types of materials indicated that site formation processes had not entirely eradicated smaller nonmetallic artifacts, thus increasing optimism that the site might contain other types of small artifacts with some degree of horizontal integrity. The artifact assemblage, as a whole, might yield valuable data regarding the effects of high-energy environmental processes on a historic shipwreck site and have applicability to other submerged sites. Such information would add to a small but growing body of research.

6

MAPPING AND RECOVERY OF *WESTFIELD*

Chapter 4 presented a synopsis of *Westfield*-related projects that were conducted through 2007, including investigations performed under previously uncompleted antiquities permits 3878 (contract D.O.s 0004 and 0005) and 4622 (D.O. 0006). This chapter will present a discussion of the remaining and final *Westfield* investigations, all of which were associated with artifact recovery operations conducted in 2009 under Antiquities Permit 5271. Those investigations included a post Hurricane Ike remote-sensing survey to assess the prediving site conditions and to identify two associated anomalies (D.O. 0006, Modification 1); underwater methods evaluations and test excavations of site 41GV151 (D.O. 0006, Modifications 1 and 2); and archeological monitoring of large artifact retrieval, clamshell bucket, and electromagnet artifact recovery operations (D.O. 0006, Modifications 3 and 4). The test excavations and artifact recovery operations were further regulated under NHHC Permits for Intrusive Archaeological Research on U.S. Naval Cultural Resources No. PBSJ-2009-001, and No. PBSJ-2009-0002, respectively.

ADDITIONAL SITE INVESTIGATIONS AND ARCHEOLOGICAL ASSESSMENT OF TWO MAGNETIC ANOMALIES (D.O. 0006, MODIFICATION 1)

D.O. 0006, Modification 1 was designed to accomplish multiple objectives relative to the mitigation of site 41GV151 due to impacts from the TCCIP. Those objectives included (1) determining the effects on the site from the passage of Hurricane Ike in September 2008, especially regarding any changes in the amount and locations of exposed artifacts/objects as compared to prestorm surveys of the site; (2) determining the horizontal extent of artifacts/objects with respect to the contiguous magnetic anomaly over the known site area in order to see if portions of that anomaly could be excluded from further investigation; (3) providing details regarding artifact types and frequency that will be useful for scoping future dive and conservation efforts; (4) assessing the spatial integrity of the site to see whether the arrangement of artifacts/objects on the seafloor resembled their relative positions within the hull of the once-intact ship; and (5) testing the efficacy and efficiency of methods proposed for site documentation.

Fieldwork tasks to be performed consisted of (a) a posthurricane remote-sensing survey of site 41GV151, using side-scan and sector-scan sonar and underwater video mounted on a ROV; (b) underwater archeological test excavations of site 41GV151; and (c) archeological diving assessment of two magnetic anomalies located near site 41GV151, Target 1 and GV0044 (Figure 48), to determine whether they might be associated with other shipwrecks.

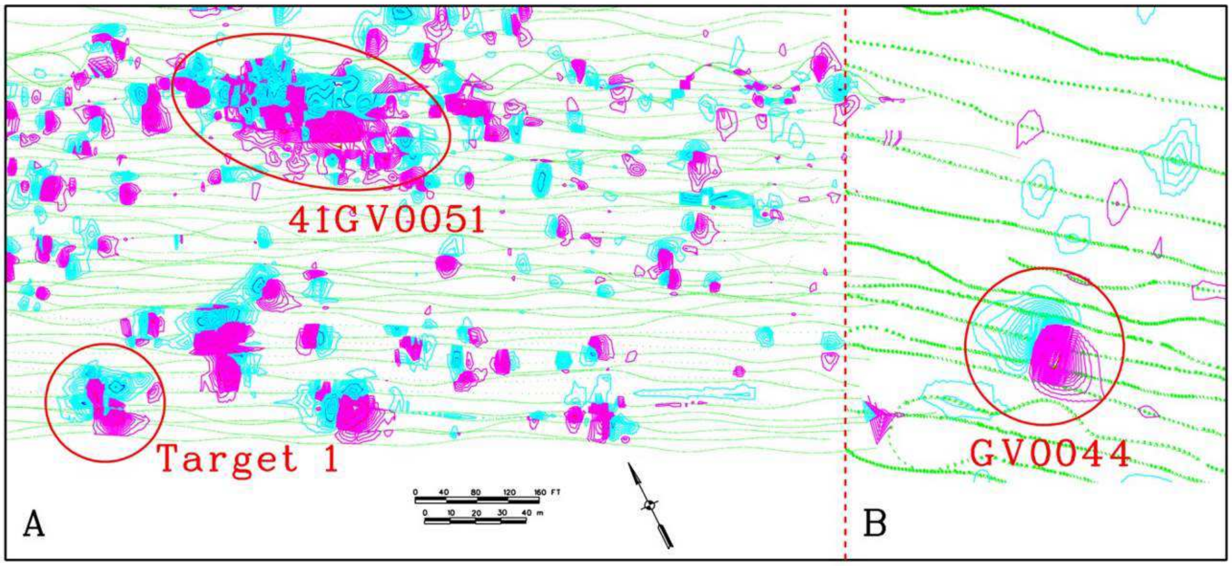

FIGURE 48. SITE 41GV151 AND ANOMALIES TARGET 1 AND GV0044. COMBINED MAGNETOMETER DATA FROM (A) THE 2007 *WESTFIELD* ORDNANCE SURVEY AND (B) THE 2007 GALVESTON-BOLIVAR CAUSEWAY SURVEY

The Target 1 and GV0044 anomalies were located outside of the known *Westfield* site boundary, but were selected for further investigation because they were located within the margins of the TCC (and therefore would be impacted by proposed channel deepening), and exhibited dipolar magnetic signatures indicative of potential shipwrecks. Discussions with the USACE and THC concluded that these anomalies should be investigated to determine whether they were discrete shipwrecks unrelated to site 41GV151. Target 1 was first recorded during the D.O. 006 *Westfield* ordnance survey of the TCC in 2007 (Borgens, Hudson et al. 2007), approximately 144 m (157 yards) from site 41GV151 and inside the southern boundary of the TCC. GV0044 was recorded during the close-order remote-sensing survey of five anomalies, conducted under D.O. 0002 (Gearhart et al. 2005). GV0044 was not one of the five targeted anomalies surveyed during that project, but was inadvertently recorded at the margins of the survey area, approximately 300 m (328 yards) from site 41GV151 and inside the southern boundary of the TCC. At the time, it was suspected to be a sunken channel buoy, but that could not be confirmed from the magnetometer and sonar data alone. GV0044 was surveyed again during a 2007 survey for a proposed Galveston-Bolivar Causeway (Borgens, Hoskins et al. 2007). Figure 48 illustrates GV0044 and the ordnance survey data at the same scale but from two different surveys.

Posthurricane Remote-Sensing Survey of 41GV151

The posthurricane survey of *Westfield* was conducted from March 30 to April 4, 2009, by Robert Gearhart, Doug Jones, and Dan Hudson. Survey equipment included the 25-ft aluminum-hulled research vessel *Howard Post*, an Edgetech DF100 side-scan sonar with CODA data acquisition software, a Kongsberg MS1000 sector-scan sonar, and a Seabotix LBV150 ROV.

Both the side-scan and sector-scan sonar data were compared to remote-sensing data collected from previous surveys. The comparison showed that site conditions had not significantly changed, relative to their prehurricane condition. The orientations of large artifacts (i.e., the cannon, boiler flues, and firebox) had not changed, though there was marginally less small debris visible. This may have been due to storm-induced mobilization of artifacts, increased burial, or may have also been a function of differing data resolutions that were dependent on the angle, distance, and orientation of sonar passes relative to low-profile objects on the seafloor. In either case, no alterations were recommended for the planned diver test excavation and artifact recovery operations. The ROV imagery were inconclusive because stronger-than-average on-site currents prevented controlled navigation of the ROV across the site.

Assessment of Target 1 and GV0044

Both Target 1 and GV0044 were surveyed during the same March 30 to April 4, 2009, window as the posthurricane survey of 41GV151. Target 1 was unable to be imaged by either the ROV or sector-scan sonar. As with the ROV attempts over *Westfield*'s site, strong currents made controlled navigation of the unit impossible. A severe norther also struck Galveston Bay on the afternoon of April 4, which forced an end to survey operations before the sector-scan sonar was able to be deployed at Target 1. Accordingly, investigation of Target 1 remained a priority during the planned diving operations on 41GV151, scheduled for May 2009. The results of that investigation are presented later in this chapter.

ROV imagery was also not collected at GV0044 for the same reasons as stated above. Sector-scan data, however, conclusively identified the source of GV0044 as a submerged modern channel buoy (Figure 49). Based upon the survey data, GV0044 was recommended for cultural resources clearance with no further work required (Gearhart 2009; Hoskins 2009). The Texas State Marine Archeologist concurred with this recommendation in April 2009 (Hoyt 2009).

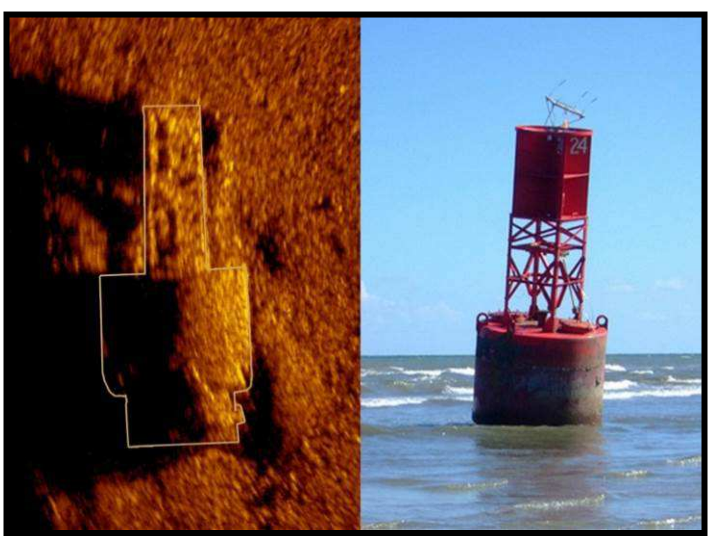

FIGURE 49. HIGHLIGHTED SECTOR-SCAN IMAGE OF GV0044 (L) AND CHANNEL BUOY FOR COMPARISON (R)

41GV151 TEST EXCAVATIONS AND FURTHER INVESTIGATIONS OF TARGET 1 (D.O. 0006, MODIFICATIONS 1 AND 2)

In May 2009, divers from Atkins tested underwater mapping and artifact recovery methodologies at site 41GV151. The objective of the fieldwork was to determine the horizontal extent of the visible artifact assemblage in respect to the contiguous magnetic anomaly; assess the types and frequency of artifact materials and wreck features; assess spatial integrity of the site; and test efficacy and efficiency of field methods as a means to guide future investigations at the site. Divers also attempted to locate and identify the anomaly source for Target 1 using systematic hydroprobing and surface searches.

Field Methods

Diving commenced on May 5 and concluded on May 26, 2009, after a mid-month, 4-day respite due to unworkable tidal currents. The dive crew utilized the 65-ft vessel *Maverick* and a three-man crew subcontracted through G&S Marine, Inc. of Port Aransas, Texas. The dive team consisted of divers Doug Jones (dive supervisor), Amy Borgens, Sara Hoskins, Raymond Tubby, and Matt Elliot; dive tenders Starr Cox and Justin Winn; and Principal Investigator Robert Gearhart. Divers used a surface-supplied air system with AGA and Kirby Morgan KMB-18 full-face masks. Typical dive depths on the site ranged from 47.0 to 50.0 ft. A USBL beacon was affixed to each diver, which allowed their locations to be monitored and recorded in HydroPro navigation software and also juxtaposed their positions against a sonar image of the wreck site.

According to the scope of work for Modification 0001, the project would chiefly involve the excavation of a series of 10-x-10-ft grids positioned at preselected locations across the site. To guide investigations, the project area was divided into three zones (Figure 50). Zone 1 included areas of exposed artifacts/objects; Zone 2 was suspected to be an area of buried artifacts/objects within the highest amplitude (>50 nanoTesla [nT]) portions of the site's main (i.e., contiguous) magnetic anomaly; and Zone 3 was suspected to be an area of buried artifacts/objects within the lowest amplitude (<50 nT) portions of the main magnetic anomaly. Figure D-9 in Appendix D illustrates the sample areas that were selected for the May 2009 work.

The plan called for at least two divers to be simultaneously employed on the site dredging and/or mapping and recovering artifacts from the grid units. Two aluminum grids, each measuring 10 x 10 ft, were fabricated specifically for that purpose. Each grid frame was equipped with a sliding cross bar that could be used for measuring the provenience of artifacts anywhere within a grid. Measuring tapes were taped to the cross bar and one side bar of each grid frame. The corners of each frame were constructed of two nested vertical tubes such that the frame, affixed to the outer tube, could be leveled over uneven terrain and then held in position by a set screw. The inner tube rested on the seafloor and was held in place by a 4-ft section of steel rebar, which was hammered into the seafloor and labeled with grid coordinates to serve as a semipermanent marker at the corner of each excavation unit as work progressed across the site.

Excavation of sediments within each excavation unit was to be conducted using a 4-inch water-induction dredge powered by a 2-inch, 5.5-horsepower pump. Two-inch water hose was used to deliver water to the dredge head in order to minimize loss of pressure at the seafloor. Technicians employed by the rental company supplying the pump advised Atkins that, given the length of hose required to reach the site from the dive boat, either increasing the pump horsepower or running two pumps in tandem would have minimal effect on the suction induced at the dredge unless the diameter of the water hose was correspondingly increased. Experience has shown, however, that a 2-inch hose is the maximum size easily managed by a single diver in a low-current situation. Furthermore, a larger hose would have significantly more drag than a 2-inch hose, further reducing the duration of workable current windows.

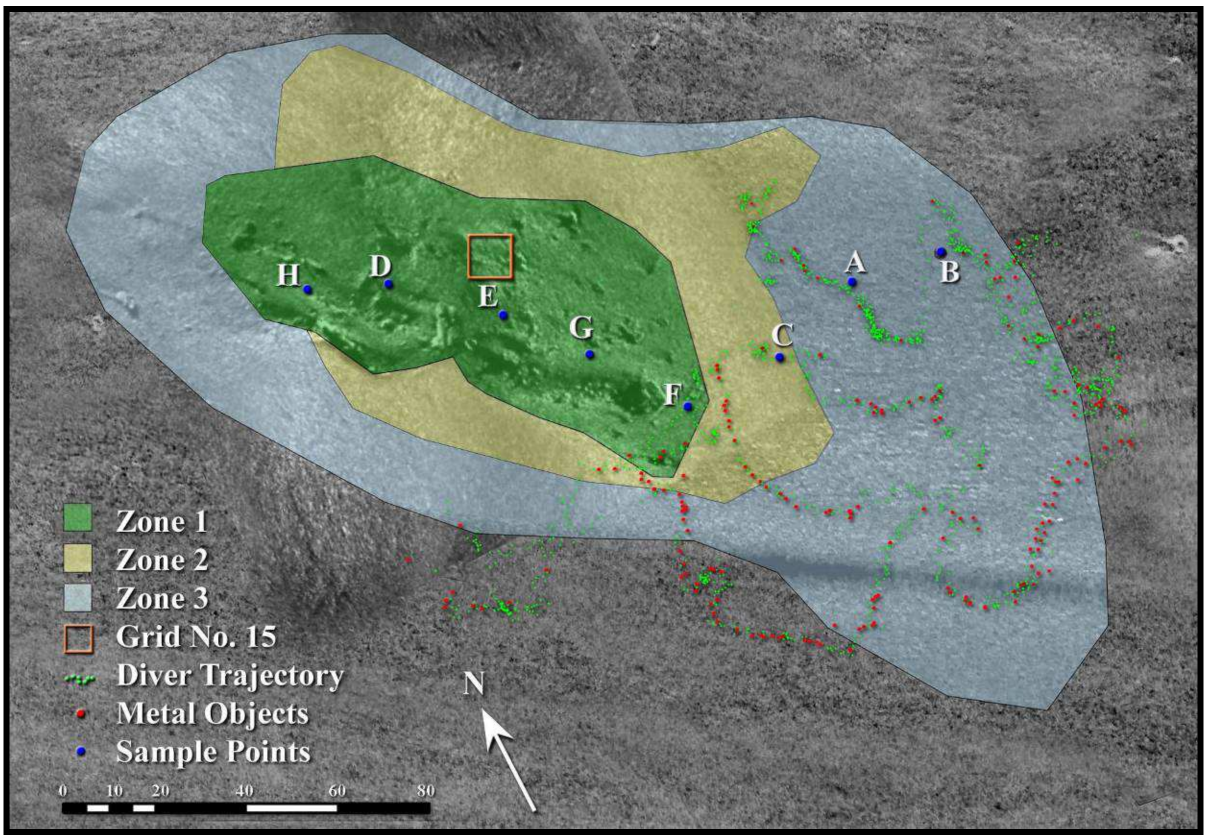

FIGURE 50. FIELD RESULTS FROM MAY 2009

Screening of diver dredged sediment on the surface was not considered feasible. An air-induced suction dredge (commonly known as an airlift) was considered for this task; however, an airlift would require a large-diameter rigid pipe extending through the full height of the water column and a lateral hose of equal size to carry sediment to the screening station. The weight of the pipe, let alone the drag of even a light current, would render such a system unworkable for divers in this environment. Discussions with dredging contractors later confirmed that the only diver-controlled, mechanical dredging technology capable of delivering sediment slurry 47 ft to the surface would require running all the artifacts through an impeller. Thus, the decision was made to attempt screening artifacts on the seafloor, and the intake end of the dredge head was covered with a screen in order to prevent loss or displacement of small artifacts. Initially a ¼-inch mesh was used; however, that was quickly replaced by a chicken wire mesh in an attempt to prevent constant clogging of the screen by shell hash. Ultimately, even chicken wire proved subject to nearly constant clogging.

Weather and tidal conditions hampered the progress of excavation and forced a reassessment of methods in order to ensure completion of key objectives. For example, visibility on the bottom was greatly diminished from previous dive seasons on the wreck. This change was presumed due to upstream precipitation patterns. Divers in May 2009 had between 2 and 6 inches of visibility with a flashlight, and the decrease in visibility compared with August 2005 and June 2006 prolonged the time taken to complete tasks. Due to these difficulties and the dense sediment encountered, the USACE issued Modification 0002 to implement changes to the scope of work that would allow investigators to meet the objectives proposed for the project. In particular, it was important that artifact density was characterized within zones 1, 2, and 3, as that information was needed in order to finalize the research design for recovery of artifacts from the site. These changes were made through consultation with the USACE, NHHC, Atkins, and the THC. The USACE Contracting Officer gave Atkins verbal authorization to proceed with Modification so that the work could be conducted while the dive team was still mobilized and in the field. Modification included metal detection of the seafloor within all three zones and batch collection of artifacts in Zone 1. Work on Modification 2 commenced on May 19, 2009.

May 2009 dive investigations accomplished four principal tasks (see Figure 50): (1) partial excavation of grid unit 15; (2) dredging and/or artifact recovery at preselected sample points; (3) metal detection in zones 2 and 3; and (4) diver ground-truthing of Target 1. Between May 5 and May 26, 2009, Atkins divers completed 21 dives on USS *Westfield*, and 3 dives on Target 1 (Table 9). An additional eight dives were required to set up equipment at sample locations. Testing was completed at eight sampling locations (A through H) and in unit 15 (see Figure 50). Testing of dredge operations and evaluation of sediment types was accomplished in unit 15 and sample locations A–C.

Unit 15

The 10-x-10-ft excavation grid was placed over unit 15 (see Figure 50; see also Appendix D, Figure D-10), in Zone 1, which was the visible artifact debris field. Six dives were conducted in unit 15, though half of the dives were used to move and anchor the grid.

TABLE 9. MAY 2009 DIVE TIMES

Date	Dive No.	Diver	Dive Times	Bottom Time (minutes)
5/5/2009	1	Sara Hoskins	16:06–17:40	94
5/7/2009	2*	Matt Elliott	11:46–11:59	13
5/7/2009	3	Matt Elliott	15:26–16:29	63
5/8/2009	4	Ray Tubby	13:01–14:04	63
5/9/2009	5	Sara Hoskins	11:28–11:41; 11:50–13:05	88
5/10/2009	6	Matt Elliott	12:32–13:46	74
5/10/2009	7	Amy Borgens	14:30–15:34	64
5/11/2009	8	Ray Tubby	12:28–13:58	90
5/11/2009	9	Doug Jones	14:27–15:57	89
5/11/2009	11	Sara Hoskins	16:27–17:10	43
5/12/2009	12*	Amy Borgens	12:06–12:18	12
5/12/2009	13	Amy Borgens	14:40–15:56	76
5/12/2009	14	Matt Elliott	16:49–18:15	86
5/13/2009	15*	Ray Tubby	14:46–14:58	11
5/13/2009	16	Ray Tubby	15:38–16:50	71
5/13/2009	17	Doug Jones	17:07–17:52	45
5/19/2009	18	Doug Jones	14:27–15:44	77
5/19/2009	19*	Ray Tubby	16:50–17:10	20
5/20/2009	21	Ray Tubby	12:05–13:33	87
5/21/2009	23	Ray Tubby	11:41–13:12	91
5/21/2009	24	Matt Elliott	14:14–14:38	23
5/21/2009	25	Doug Jones	15:04–16:27	83
5/23/2009	27	Amy Borgens	10:36–11:57	81
5/25/2009	28†	Doug Jones	12:22–13:51	89
5/25/2009	29†	Matt Elliott	14:17–14:40	22
5/25/2009	30†	Amy Borgens	15:28–16:02	34
5/26/2009	31	Doug Jones	12:50–14:15	84
5/26/2009	32	Amy Borgens	14:57–16:17	79

* Dive aborted due to heavy currents and/or ship traffic with no work accomplished

†Dive on Target 1

One difficulty encountered during work on unit 15 was moving the aluminum grid by a single diver when positioning it on the site. It was inadvertently placed upside down on-site and could not be "flipped" right side up due to the current. The two cross pieces that were marked with measuring tapes had to be unpinned and rotated so that they could be viewed for mapping. A second unanticipated problem was the occurrence of fine sediments sandwiched between the basal clay and the shell hash. Subsurface work from previous seasons had been limited to probing, which met little resistance until encountering the basal clay at an elevation of –46.9 ft USACE MLT, thus the existence of artifact-bearing sediments, more resistant to a 4-inch water induction dredge than shell hash, was unexpected. That fact, combined with the short dive windows afforded by the tides, resulted in slow progress, and unit 15 was not sufficiently cleared of sediment to allow either in situ mapping or batch collection of artifacts. Finally, the system for covering the intake of the dredge with ¼-inch mesh, as a filter, proved unsuccessful. It was replaced by larger chicken wire to prevent clogging of the screen but this was also prone to clogging with shells. The chicken wire covering was clipped to create larger filter holes but the suction of the dredge forced this open to such an extent that the 4-inch intake was merely bisected by a single wire. Because of repeated clogging, the use of a screen on the dredge intake was not a successful solution for preventing the accidental removal of small artifact materials from the site.

Sample Point Dredging and Artifact Recovery

Atkins divers dredged at sample points A, B, and C to test the efficiency of the dredge setup (Table 10). A 5.5-horsepower pump used to operate the dredge was found to be underpowered and not capable of drawing enough suction to effectively remove sediment. Improvised digging apparatus, in the form of dive knives or large shells, were used to break up the compacted sediment; otherwise it could not be dredged. In total only 3 to 4 cubic ft of sediment was removed per hour.

Sample points D, E, F, G, and H were used solely for surface artifact recovery (see Table 10). The HydroPro navigation software contained a geo-referenced sonar image of the site that was used to select general areas that had the potential to yield small portable artifacts. Once a diver descended to the site, he/she was directed toward a general focus area. When at the desired position the diver manually felt the seafloor in order to select the best possible location to embed a marked rebar post. A measuring tape was then attached to the post and used to conduct a circle search. The sizes of the search areas varied (see below).

Metal Detection in Zones 2 and 3

Two dives, conducted on May 19 and May 20, evaluated portions of zones 2 and 3 with an Imtrex, Inc. Seatrec 1 underwater metal detector. The purpose of this task was to estimate the density of metal artifacts buried beyond the visible debris field (Zone 1 on Figure 50). An area of roughly 1,167 square yards was swept by the metal detector in the eastern half of the site. As the diver moved across the bottom sweeping the metal detector in a 6-ft-wide arc, the diver path and the locations of each hit from the metal detector were recorded in HydroPro based on USBL positions and diver communications.

TABLE 10. MAY 2009 DIVE SAMPLE POINTS

Sample Area	Zone	Number of Dives	Work Accomplished
A	2	3	Dredging of a 3-ft round hole 6 to 10 inches deep revealing a shell hash layer approximately 1 to 2 inches deep overlying a dense shell and clay layer approximately 8 inches deep overlying sterile clay; sediment sample of the shell hash layer.
B	3	3	Dredging of a 4-ft by 2- to 2½-ft ovular hole approximately 10 to 13 inches deep revealing 2 to 3 inches of shell hash overlying 8 to 10 inches of dense shell and clay overlying sterile clay; sediment sample of clay layer; collection of an iron artifact and two wood fragments.
C	2	2	Dredging of a 1½-ft by 2½-ft ovular hole approximately 10 inches deep; dredging of a 2-ft round hole approximately 10 to 12 inches deep; collection of a piece of coal from the shell hash layer.
D	1	1	Surface collection of 17 portable artifacts within a 12-ft radius of point D.
E	1	2	Search for portable artifacts within a 10-ft radius of point E – no portable objects found, only numerous, mostly buried, large artifacts.
F	1	1	Surface collection of 7 portable artifacts within a 4-ft radius of point F in a wedge extending from north of point F to west-northwest of point F.
G	1	1	Surface collection of 6 portable artifacts within a 10-ft radius of point G.
H	1	1	Surface collection of 11 portable artifacts within a 10-ft radius of point H.

Diver Ground-Truthing of Target 1

Target 1 is characterized by two adjacent dipole anomalies and a sonar target, and is located on the south side of the channel approximately 144 m (157 yards) from the wreck of *Westfield.* A total of three dives were conducted on Target 1 and consisted of diver probing and bottom investigation (Figure 51).

Results

A 4-x-5-ft area of unit 15 was cleared of loose shell hash that was roughly 6 inches deep. The diver conducting the dredging was unsure whether sterile clay was reached during the course of work due to the dense nature of the sediment underlying the shell hash. One large immovable artifact was encountered buried in the excavation unit. A total of three small artifacts were collected from the top 6 inches of shell hash; two fastenerlike concretions were on top of the sediment. The most diagnostic artifact recovered during the May 2009 field session was collected during the final dive at unit 15, while retrieving a sample of shell hash. This was a lead Union belt buckle stamped “US” (Artifact 6; see Figure 46). The outer brass plating had long since deteriorated.

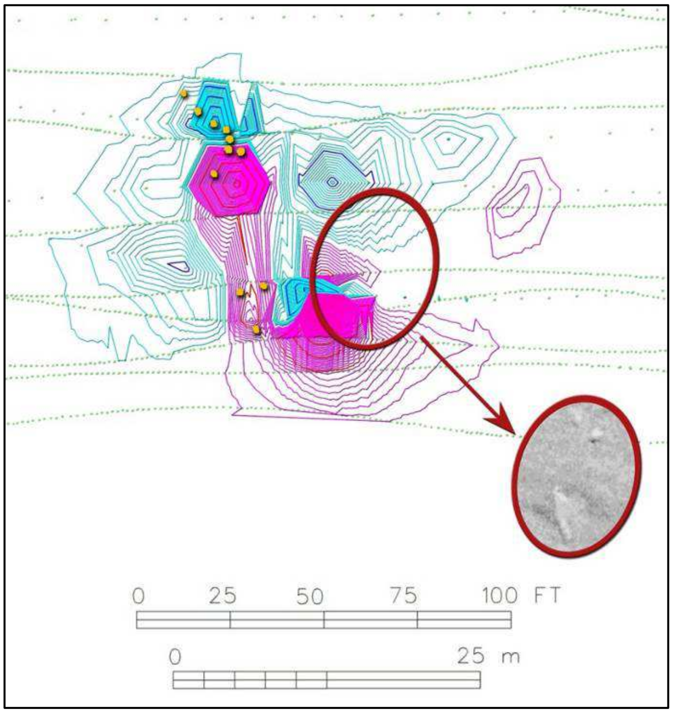

Figure 51. Probe Locations at Target 1

Only four artifacts were recovered during dredge operations at sample points A, B, and C: a concreted ferrous bolt (Artifact 9), a piece of coal (Artifact 11), and two roughly similar small wood fragments (Artifact 10), the latter of which are believed to be modern and possibly intrusive. The top layer of sediment in sample points from zones 2 and 3 was characterized by 1 to 3 inches of loose shell hash. The lower layer was a mixture of a compacted claylike loam intermixed with shell hash. This claylike layer of sediment was 8 to 10 inches thick, directly atop sterile clay and was difficult to dredge. A total of 41 artifacts were collected from within a 4- to 12-ft radius at sample points D, E, F, G, and H. Larger immovable objects were encountered at several of the sample points. Almost all of the objects recovered from the site appear to be ferrous with the exception of two cuprous items (rods or bolts), the aforementioned lead buckle, a coal fragment, and intrusive wood. Many of the concreted ferrous objects were fasteners or ship fittings.

Metal detection over portions of zones 2 and 3 (see Figure 50) demonstrated that these areas are characterized by the consistent presence of buried metal objects, most of which are closely spaced at intervals of less than 10 ft. Some areas in zones 2 and 3 contained as many as eight separate buried metal objects within a 10-ft linear trajectory measuring about 6 ft wide. This roughly equates to a density of 1.2 metal artifacts per square yard.

Target 1 was investigated by three divers during the May 2009 field session. Eleven probes were placed at the anomaly (indicated by the orange points on Figure 51), and a visible debris field at its source was encountered by two divers. The depth of sediment above hard clay ranged from 1.0–4.0 ft; all probe locations were negative for buried artifacts or shipwreck features. Sediment was slightly different than that encountered on the north side of the channel. The upper loose layer of shell hash at Target 1 was roughly 6 inches thick. Underneath this layer was a very soft clay loam that was intermixed with shell hash.

The source of the more-southern of the two dipoles at Target 1 was ruled out as as a standalone shipwreck but, instead, was a collection of pipes and large ferrous concretions, similar to those encountered at site 41GV151. The divers observed at least nine artifacts on the seafloor: two small portable items, one of which appeared to be a concreted fastener; two wood objects, one of which was buried, though 3 to 4 ft were exposed above the sediment; two concreted large damaged pipes—one with a diameter of approximately 2 ft; concreted plating ½-inch thick; and several immovable amorphic concretions. Almost all of the objects were partially buried and protruding from the sediment. A couple of objects resembled large damaged pipes consistent with the types of materials expected from an exploded shipwreck.

Sonar imagery shows at least three objects congregated in the area of the lower southern dipole, in the general area investigated by the diver. The largest of the objects measures approximately 16.4 ft in length on sonar. Nothing of this size was reported during the brief investigation of Target 1 so it is likely this specific artifact was not encountered during the dive. Damage to some of the objects at Target 1 was thought to be consistent with artifacts from an exploded underwater wreck site, and it was concluded by the divers that the visible features at Target 1 were similar to those from site 41GV151 and are very likely related to the wreck of *Westfield*. Later analysis of the USBL positioning for these sonar targets, however, showed that they are 10 ft south of the TCC boundary, and will therefore not be impacted by the proposed TCCIP dredging.

Recommendations for Continued Fieldwork on Site 41GV151

The Atkins dive team encountered unexpected obstacles that impeded work in May and were viewed as similarly impacting continued investigations at the site. Following are Atkins's recommendations to the USACE as as they were presented at the conclusion of the May fieldwork (Borgens and Hoskins 2009):

- **Current activity and dive operations**. Atkins previously conducted two successful dive ventures at the wreck site, prior to the May 2009 work. The high-energy underwater conditions at the site are well-known to the Atkins divers. Due to the nature of the present work, principally dredging and the movement of artifacts across the site to the dive boat, it was discovered that the best maximum working conditions occurred when the tidal current was under ½ to ⅔ of a knot. Between ⅔ and ¾ of a knot, the action of the current on the dredge hose in the water column and drag on handheld equipment and/or recovery baskets made the conditions unsuitable for work. The current predictions were not always accurate and often delayed diving on the site. The tide monitor near the wreck was out of service so that only the tides at the Galveston Entrance Channel could be accessed, and these were not always representative of conditions at the dive site. In addition to monitoring real-time tidal conditions via the internet, the dive crew visibly observed topside conditions at the down-line and dive ladder. Due to the type of work required for mapping and recovery of the wreck, the window of opportunity for future diving on the site will likely be more conservative than what was predicted for the May 2009 field session.

- **Current activity and boat operations**. Anchoring the boat in Galveston Bay, with the combined wind and tidal currents, was a lengthy and difficult process. Anchoring could take upwards of 3 hours, and the time required for this process was variable due to each day's weather and tidal conditions. Removing the anchors could sometimes take 2 to 3 hours, and on three occasions the boat became fouled with the anchor lines, or nearly so, due to a shift in currents. Two fouled anchors were purposely cut from the vessel so that the boat could proceed to the marina. On two occasions the change in current caused the boat to slip its anchorage and move into the TCC—on both occasions a dive was aborted or ended prematurely. Approximately one-third of all dives on the site were abbreviated due to the action of the current on either the boat or diver.

- **Ship Channel Traffic**. Vessel traffic on the HGNC and TCC was highly detrimental to work progress. This was anticipated with the TCC, but on several occasions, ship traffic on the neighboring HGNC interfered with work on-site. On separate occasions, a heavily burdened vessel drew enough water to cause *Maverick* to drag anchor and get pulled into the TCC. Twice this occurred between dive rotations, and the following dive was aborted due to the time required to re-anchor the boat. In one particular instance the *Maverick* was moved approximately 100 ft into the TCC while a diver was on the seafloor, thus pulling the diver across the bottom. On another occasion, two large tankers passed one another in the HGNC. The reduction in vessel speed, combined with the strong wind, caused one of the tankers to move into the northern boundary of the TCC, exactly in the area the *Maverick* was to anchor. At the time, *Maverick* was waiting for ship traffic to subside in order to begin the anchoring process.

- **Simultaneous 2-diver investigation from a dive boat**. Atkins anticipated employing two divers simultaneously on-site. This process was never tested during the May 2009 dive operation largely due to the change in work methodology. There was not an opportunity to have a diver mapping and a diver dredging at the same time. Had the work conditions been favorable for a 2-diver work team, it is highly doubtful that this would have been successfully conducted. The small size of the boat deck would have forced both divers to use the same point of entry. The heavy tidal currents and surface currents (sometimes acting in opposite directions) would have likely caused the divers' umbilicals to become entangled or otherwise tangled with other hoses and lines. This was already an issue with a single diver, the down line, and artifact basket line. It is highly recommended, for safety issues, that divers do not use the same point of entry for diving on USS *Westfield* due to strong tidal and surface currents present at the site.

- **Filtration of Dredge Spoil**. The small 4-inch dredge and 5.5 horsepower pump were not able to effectively clear large portions of material from the site in a timely manner. A screen was placed over the intake to prevent small objects from being sucked into the dredge. The screen constantly clogged and was successively replaced by two different larger variants: the largest of which was more efficient for dredging but would not prevent the accidental removal of small materials. The out-take hose was only 10 ft long wherein small artifacts accidentally sucked into the dredge would be redistributed to other areas of the site.

The May 2009 field session confirmed that strong tidal currents and ship traffic in both the TCC and HGNC not only restricted work time but periodically caused the dive boat to drag its anchors and move into the TCC. As a means to facilitate fieldwork and ensure a safer dive environment, Atkins proposed a 24-hour crew rotation (2 dive windows) from a semipermanent spud barge/dive platform positioned at the site and next to the channel as a means to enable dive investigations. Strong tidal currents, however, would continue to limit diver bottom time at the site, greatly impede work, and would prolong the fall/winter field session. It was concluded that a multi-month fieldwork session required for diver mapping and recovery of artifacts placed both the divers and equipment at undue risk from weather and the extensive commercial ship traffic and recreational vessel traffic inherent at that location. Through The next phase of work, the removal of the site from the TCC, was commenced in November 2009.

SITE RECOVERY, CATALOGING, AND THE ARTIFACT ASSEMBLAGE, FALL 2009 AND WINTER 2010 (D.O. 0006, MODIFICATIONS 3 AND 4)

Consultation with the USACE, NHHC, and THC determined that the safest method for recovery of the site was through industrial mechanical devices and by primarily relying upon a clamshell dredge operated from barges anchored at the side of the TCC. The USACE, through consultation with Atkins, the NHHC and the THC, coordinated with the Navy Supervisor of Salvage (SUPSALV) for an archeologically supervised recovery of artifact-laden sediment and shell hash from the wreck site. SUPSALV directed the heavy-lift barge operations through a series of industrial contractors and subcontractors. Atkins' Principal Investigator directed archeological operations. Working together, SUPSALV, Atkins, and a large team of subcontractors recovered artifacts and sediment from 9,450 square feet (0.2 acres) of the bay bottom.

The duration of fieldwork was drastically reduced from estimates for traditional methods discussed above, despite the fact that work was performed in November and December. The recovery effort included the use of commercial divers, an electromagnet, and an environmental clamshell bucket. Fieldwork required 33 days from start to finish. Combined mobilization and demobilization of barges and equipment on site required 8 days. Commercial diving to assist with lifting the largest artifacts required 17 dives conducted over a period of 8 days partially concurrent with other operations. Lifting of iron artifacts from selected areas by electromagnetic took place over a 3-day period. Clamshell operations required 16 days. Reports by SUPSALV and their subcontractors are included in Appendix B.

A virtual site grid was established to guide the recovery effort, providing a means by which to track the provenience of artifacts (Figure 52). The grid dimensions were increased to 15 x 15 ft (from the 10 x 10 ft originally proposed for traditional archeological recovery methods above). The revised grid size was chosen based on a combination of factors including the 6 x 9-ft size of the clamshell bucket in its open position, an estimate of how much sediment would be brought up in each load, and the accuracy with which each clamshell grab could be positioned on the seafloor. A 15 x 15-ft grid size required a minimum of 6 clamshell grabs to recover the sediment from a single grid unit. More than 6 grabs were collected from units if warranted by the sediment yield. The containers used to transport and screen sediment from each grid could accommodate all of the material anticipated from a single 15 x 15-ft unit. The position accuracy of each clamshell grab was plus or minus about 3 ft, so using a grid as small as 10 x 10 ft would have been overstating the confidence that a particular grab was actually retrieved from the intended grid unit.

The artifact and sediment recovery task was conducted in a total of 42 grid units (Figure 52), each measuring 15 x 15 ft. The first three digits of each artifact number indicate the grid from which it was recovered. The area selected for recovery originally incorporated all portions of zones 1 and 2 (Figure 50) within the TCC. The grid was modified as fieldwork progressed, based on artifact density from adjacent areas. Four grid units (101, 126, 127, and 142) originally planned along the northwestern margin of the site were removed from the recovery plan, due to a low artifact density in adjoining units, and were replaced by four other units (144 and 151–153) along the southeastern margin of the site. Locations of the four replacement units were selected to coincide with magnetic anomalies in hopes of identifying artifacts that could confirm the position of the ship's bow. The approximate bow location was based on the known distance from the smokestack (located over the firebox) to the bow (see Figure 3), combined with the assumptions that the firebox and Dahlgren cannon have not moved laterally. The firebox is believed to be close to its original position within the ship, as most of the fire grates were still in place, held there only by gravity; however, there is a suspicion that it was rotated and possibly dragged a short distance during removal of the boiler it was once attached to.

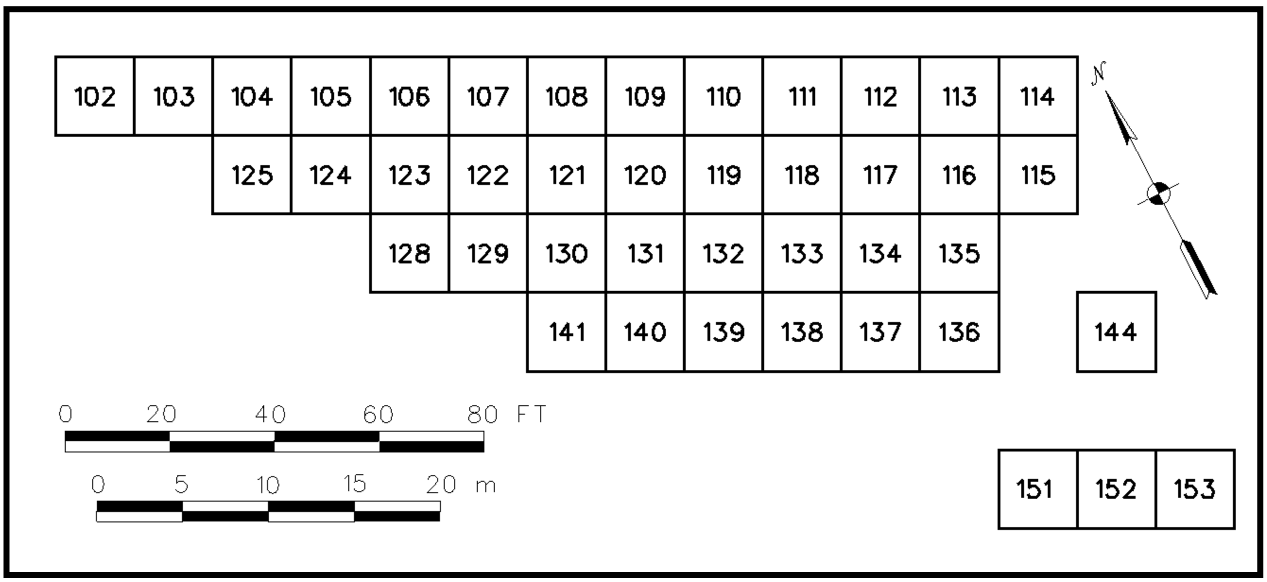

FIGURE 52: 41GV151 SITE GRID.

The largest artifacts, when feasible, were individually crane lifted from the project area prior to sediment recovery. Other large artifacts, believed too large for the clamshell, were lifted using the electromagnet. Once attempts to lift large artifacts were completed, sediment was collected from across the site using an environmental clamshell bucket deployed from a crane. The position of each lift was determined with the highest possible degree of accuracy, given the recovery method, using GPS and geographic positioning software.

All recovered artifacts and sediment were transported to Freeport, Texas, to be screened and documented by a team of archeologists. All the artifacts recovered from the site were photo-documented and cataloged prior to being delivered to the CRL. A total of 28 archeologists worked in Galveston and Freeport in the fall of 2009. The field crew was initially small and included 11 archeologists at the Galveston site until screening commenced. At this juncture, a portion of the Galveston field crew was relocated to Freeport (leaving 6 crew members at the wreck site) and supplemented by 17 additional archeologists. Atkins senior staff members managed the three main archeological tasks for the Galveston and Freeport fieldwork. Robert Gearhart and Doug Jones were responsible for directing the crane operations and selecting grids for recovery. On-site responsibilities for this work were interchangeable: one archeologist was stationed at the crane itself, while the second was working with the navigation team—both archeologists monitored the clamshell and magnet recovery. Sara Laurence managed a team of archeologists responsible for recording provenience of each lift relative to its respective filter box and for recovering, packing, and labeling individually recovered artifacts for shipment to Freeport. Amy Borgens managed cataloging and documentation of the artifacts while on-site at Galveston and supervised the Freeport screening and cataloging operation. Doug Jones, as the Atkins Dive Supervisor, was prepared to lead the Atkins archeological dive team, in the event of unanticipated in situ discoveries, and additionally coordinated with the commercial dive team regarding dive objectives.

The presence of "live" ordnance on the site created certain complications for the fieldwork. The Environmental Branch of the USACE, Galveston District coordinated with the U.S. Army Engineering and Support Center, the USACE, Environmental and Munitions Center of Expertise, Military Munitions Division (both of Huntsville, Alabama), and the U.S. Department of the Navy to perform assessments and develop safety protocols for the removal, handling, and transport of Munitions and Explosives of Concern (MEC).

An MEC Hazard Assessment (USACE 2009a) was performed to determine potential hazards associated with the deliberate removal, handling, and preservation of artifacts recovered from USS *Westfield*, especially munitions of the explosive variety that would have been filled with black powder. The results of a qualitative hazard evaluation classified the munitions from the wreck site as "insensitive" if properly handled and maintained in an aqueous environment, and "highly sensitive" if allowed to dry out. The conclusion of this assessment was that the overall safety hazard associated with the removal and handling of *Westfield*'s MEC was low as long as they were kept wet and properly handled.

Prior to the collection of any MEC, the Navy prepared an Explosives Safety Submission for the removal of the ordnance from the site (U.S. Department of the Navy 2009). The scope of this document only covered the recovery of ordnance, not the disposal or treatment of them, nor transport beyond the designated collection point. This document identified the primary Munitions with the Greatest Fragment Distance (MGFD) as the 13-inch mortar and the 9-inch shells, and declared that the identification and handling of any recovered MEC would be performed by Navy EOD specialists. Controlling exclusion zones, based on Fragmentation Data Review Forms for the primary MGFDs, were also identified for each phase of the recovery operation, along with proper recovery procedures.

Prior to the initiation of fieldwork, the USACE prepared an Explosive Site Plan (USACE 2009b) for the safe disposal of munitions and MEC from the *Westfield* site. This plan established both the collection point and the open detonation area (San Jacinto Placement Area) for the disposal (by Navy EOD) of any munitions not made inert by Marine EOD. This plan also established safety criteria, identified the Hazardous Fragment Distance (HFD) for all anticipated munitions, and laid out a procedure for open detonation of MEC (though all of the recovered munitions were ultimately made inert by U.S. Marine EOD).

Shells extracted from the site were handled by Navy EOD specialists, documented by a team of two archeologists, and transferred by boat to the prearranged open detonation area at the San Jacinto Placement Area on Galveston Island. Artifact recovery procedures were implemented to ensure all shells were collected at the Galveston site and would not be accidentally shipped to Freeport.

Artifact Recovery Methods

On-site field work for the fall 2009 recovery effort was conducted from November 14 to December 16, 2009, and consisted of four separate phases: (1) diver recovery of selected large artifacts, (2) electromagnet lifts of large ferrous artifacts, (3) systematic clamshell excavations of the site within the TCC margins, and (4) shore-based screening, sorting, and cataloging of recovered artifacts. Phases 1, 2, and 3 occurred at the location of the wreck in Galveston Bay and were conducted aboard a flotilla of three work barges (Figure 53). The fourth phase of work, screening and documentation of the artifact collection, was performed off-site at facilities in both Freeport and Austin, Texas.

Mobilization of the on-site Galveston fieldwork took four days, November 14–17, after which the first phase was commenced. Work vessels included a 120-x-40-ft barge equipped with a large (138-ton) crane. The barge included a “laydown” and sorting area for large artifacts, and the vessel positioning and navigation operations (“survey shack”); a 100-ft-long barge, equipped with a small (16-ton) crane, housed the diver operations including the communications shack, air compressor stations, recompression chamber, generators, and water pumps; and a 100-x-40-ft materials barge, carried up to nine roll-off/filter boxes used for artifact wet storage, sediment storage, and large artifact screening. The USACE contracted SUPSALV and their subcontractor DonJon Marine Co., Inc. for set-up and management of the Galveston-based barge operations. The barges and cranes were owned and operated by J&S Contractors of Freeport, Texas. Diving and survey/navigation personnel and equipment were provided by Phoenix International (under contract with SUPSALV). Atkins archeologists coordinated and supervised collection protocols to ensure adherence to the research design.

FIGURE 53. DETAIL OF BARGES DURING MOBILIZATION (PHOTOGRAPH BY AMY BORGENS)

M/V *Fling*, a 100-ft charter dive (converted crew) boat out of Freeport, served as the primary support vessel, transporting personnel from shore to the work barges, providing meal service to the crew, and temporarily housing off-duty personnel. Further support vessels included a Rigid Hulled Inflatable Boat (RHIB) and a pontoon boat, provided by SUPSALV's Emergency Ship Salvage Material (ESSM) System. These boats also provided ship-to-shore transportation and enforced a safety perimeter for any passing recreational vessel traffic. During the diving phase of field operations, the USACE and Navy SUPSALV coordinated with the USCG Vessel Traffic Control to arrange daily closings of the TCC for 6-hour periods, which were timed to coincide with the fluctuating slack-tide dive windows. These channel closings enabled the work barges to be placed within the TCC margins, which further maximized diver safety and overall efficiency of operations. The materials barges were only on-site during the hours of field operations between which they were either moored in the Galveston Ship Channel overnight or transported to Freeport when full. During all phases of on-water operations, constant communications were maintained with the USCG Vessel Traffic coordinator and with any passing ship traffic in both the TCC and HGNC.

Multibeam Survey

Phoenix International subcontracted with C&C Technologies, Inc. for a multi-beam survey of the seafloor at the wreck location. Their survey was performed in November 2009 prior to mobilization of recovery barges at the site. Multi-beam data was requested by the Phoenix dive team in order to refine the location of large objects prior to diving. The results of the survey proved less useful for that purpose than hoped; however, the data was quite helpful for interpreting sediment thickness on various portions of the site, which in turn contributed to understanding artifact distributions. The results of the multibeam survey are discussed in other sections of this report in support of various discussions (see figures 21 and 22). A survey report by Phoenix International is included as Appendix B-2.

Diving

The initial phase of fieldwork involved the use of commercial divers to prepare large, heavy artifacts for removal from the site by crane. Phoenix International conducted commercial diving operations (Figure 54). The dive team consisted of four divers, two tenders, and the dive supervisor. Diver navigation was monitored and recorded in the survey shack by Phoenix's surveyors, using a Sonardyne USBL positioning system, with diver-mounted beacons. A real-time display of diver position, overlaid on a geo-referenced sonar image of the wreck site, was simultaneously displayed in the survey shack and diver communications shack. A Atkins archeologist was stationed in the diver communications shack to monitor and consult with the dive supervisor on all diver tasks.

FIGURE 54. DIVER ASCENDING LADDER (PHOTOGRAPH BY AMY BORGENS)

Dive operations were conducted November 18–25, 2009, and consisted of 17 dives. Initially, divers were tasked with retrieving a prioritized list of large artifacts that were previously mapped by Atkins archeologists and suspected to be too large for safe recovery in the environmental clamshell dredge (see below). This included, generally, any known objects larger than 6 x 3 ft. Divers succeeded in recovering the cannon (Figure 55), the boiler flues, and the only complete example of a 5-x-5-ft boilerplate. Divers made a lengthy but ultimately unsuccessful attempt to bring up the firebox intact without disturbing the articulation of the grates. Additional items collected by commercial divers included two iron plate fragments, two straps, two spikes, and two pieces of intrusive modern palette wood.

Prioritized large artifacts were located by using the sonar imagery and USBL positioning to navigate the diver to an artifact's known location. Using the diver-mounted USBL beacon, one or more position fixes were recorded by the survey shack in order to further map an artifact's location and orientation on the seafloor. Once an object was located, identified, and mapped, slings were sent down to the diver in a basket attached to the large crane. If necessary, the diver would use a jet hose to clear channels in the sediment underneath an object for placement of the slings. Both the bearing block and the firebox were thought to be potentially too fragile to lift with the slings. The dive recovery of these two artifacts was assisted by an electromagnet (see below). After any large artifact was removed by divers, whether by magnet or slinging, divers conducted a post-lift survey of the area directly under the removed artifact in order to determine the presence or absence of any hull material or other large artifacts that may have been trapped underneath. In all cases the underlying area was devoid of further cultural material. Artifacts recovered by the dive operation were assigned a unique artifact number or provenience label and later cataloged and photographed. They were placed in a roll-off box for wet storage and transported to the CRL.

FIGURE 55. RECOVERY OF DAHLGREN CANNON (PHOTOGRAPH BY AMY BORGENS)

Electromagnet

The second phase of operations, conducted November 25–27, involved using an electromagnet to systematically remove ferrous artifacts from the seafloor. The magnet, owned and operated by SMIT Americas, Inc., measured 5.5 ft in diameter with a lift capacity of 33 tons and was deployed using the large crane (Figure 56). The purpose of the magnet was to remove known artifacts that were too large for recovery using the clamshell yet too numerous to recover by diving as originally intended. Weather delays necessitated that this method be considered in order to put the project back on schedule. All agency archeologists were consulted regarding this decision and agreed to test this methodology. The general effectiveness and safety (to personnel and artifacts) of the magnet was successfully demonstrated to the satisfaction of archeologists on the barge deck using modern objects prior to its use on the wreck site. An attempt was made to increase the effective surface area of the magnet by attaching a 10-x-8-ft steel plate (see Figure 56); however, this method proved unsatisfactory, as the magnetic charge dissipated substantially outside of the central 5.5-ft-diameter magnet surface. Positioning of the magnet was accomplished using Cable Arm's ClamVision software, a fully integrated dredge positioning system that gave the crane operator a real time view of the barge and magnet positions as they existed over the project area. ClamVision used a GPS data stream to position the magnet over the target location within the site grid. The software displayed the 3D surface of the seafloor at the wreck site created from the 2009 multibeam data. The position of the magnet on the seafloor was also visible in real time using sector-scan sonar.

FIGURE 56. DETAIL OF ELECTROMAGNET (WITH AND WITHOUT ATTACHED PLATE)

The first three magnet lift attempts were diver assisted and focused on the largest complete objects remaining on the site following removal of the cannon: the boiler flues, bearing block, and firebox. For both the bearing block and firebox, divers first jetted under the artifacts in order to allow placement of the slings. Once the slings were arranged, an electromagnet was slowly crane lowered (while powered off) and placed on top of the object by the diver. The slings were then secured to eyebolts welded to the magnet's nonreactive upper side. The magnet, therefore, acted as a spreader bar to prevent inward squeeze by straps on the sides of objects, and also distributed the lifting force across the entire surface area of the object that was in contact with the magnet. Once an artifact was secured to the magnet, the diver returned to the dive barge, the electromagnet was powered on, and the artifact was brought to the surface. Though this method was successful for the recovery of the bearing block, which was still very solid, the firebox proved too large. The straps slipped from under the sides and the magnet came to the surface with a load of fire grates, still in their relative positions. Most of the remaining fire grates subsequently were recovered using the electromagnet. The boiler flues were unable to be recovered using the magnet as the remaining ferrous components were so weak the artifact was unable to support its own weight. Instead the portions of the iron in contact with the magnet exfoliated leaving the artifact behind on the seafloor. In addition, the weight of the magnet slightly compressed the ends of the boiler flues. The boiler flues were later cradled in straps and removed using the crane.

The remaining magnet lifts were directed from the surface by selecting targets with the aid of sector-scan data. One of the primary objectives of the magnet lifts was to remove as many of the large objects that could not be recovered by the clamshell, as well as known occurrences of MEC. Positions of known large artifacts, mapped previously by Atkins divers, were used to guide the magnet to the desired portion of the site grid. Then the sector-scan sonar was used to locate visible targets at those locations and to guide the magnet into position over the targets. Objects were lifted in the order of their priority, as assigned by archeologists. Some MEC was lifted coincidently during attempts to recover other large artifacts. Once the priority list of large artifacts had been completed, the magnet was lowered into areas known from previous dive investigations to contain MEC. Eighteen shells were identified in the artifact collection, and eight of these were recovered using the electromagnet.

Once the magnet was raised, its edges were placed on blocks within the laydown area of the large crane barge with a mattress underneath the magnetic surface or within one of the roll-off boxes. The magnet was powered down and any attached artifacts gradually dropped onto the mattress, in order of their weight, as the voltage dissipated. Each magnet lift was given a unique sequential number that was mapped and recorded in ClamVision for incorporation into the site map. The artifacts from each magnet lift were photographed as a group and labeled with their corresponding magnet and grid number. Small artifacts were placed in labeled 5-gallon buckets; otherwise a label was attached to each individual artifact. A total of 280 artifacts were recovered using 43 magnet lifts. A decision was made to cease use of the magnet once attempts had been made to lift all known large artifacts and no additional hard targets were visible on the sector-scan sonar image.

Clamshell

The final phase of the Galveston fieldwork consisted of systematic clamshell dredge recovery of sediment from the site. The clamshell was a 3-cubic-yard smooth environmental bucket. The smooth environmental bucket does not have teeth and is less inclined to dig into the underlying clay bed. The clamshell measured 6 x 9 ft when open (Figure 57) and weighed 5,100 pounds empty. Environmental clamshell buckets are generally used to remove contaminated materials and, as such are designed to minimize resuspension of sediments and to protect water quality. They are manufactured to ensure minimal loss of materials during extraction.

Clamshell operations were conducted November 27–December 12. A total of 326 clamshell lifts were recovered from 42 grid units (Appendix D, Figure D-12). Positioning was accomplished using ClamVision in the same manner used for the magnet lifts. After being positioned over the target area, the clamshell was lowered to the seafloor in the open position and closed by gravity as it was lifted from the seafloor. On average the large crane lifted 4 to 5 percent of its maximum load capacity of 240,000 pounds on each clamshell lift (i.e., 4 to 5 tons), which equated to approximately 3.5 tons of sediment and water per load. Each clamshell lift was given a unique, sequential number that was recorded and mapped in ClamVision, to be later incorporated into the site map.

FIGURE 57. ENVIRONMENTAL CLAMSHELL DREDGE

The clamshell was used a minimum of six times within each grid, providing 3 ft of overlap between clamshells in one direction and 1.5 ft of overlap in the other (Figure 58). Most units required more than six lifts to clear the grid to the basal clay, as indicated by a minimal sediment yield. If the clamshell did not completely close due to a protruding artifact, or if a high volume of artifacts was consistently being recovered from a certain area, then the supervising archeologist would instruct the crane operator to continue work in that unit until it was cleared. Once a unit was deemed clear of sediment and shell hash overlying the basal clay, operations moved to an adjacent unit. In some instances, extra clamshell lifts were placed when searching for known artifacts mapped within that unit by previous diver investigations. The average number of clamshell lifts was eight per grid unit.

Each clamshell load was placed into a specialized 23-ft-long x 8-ft-wide x 5-ft-deep, watertight roll-off box containing an interior lining of steel screens of ¼ inch on the bottom and 1-inch screens on the side (termed a “filter box”). Atkins archeologists were present on the spud barge and materials barge to maintain a record of provenience for each clamshell load and filter box. Each filter box contained a removable inset 6-inch steel screen so that any MEC within the sediment could be identified and removed during this phase of the operation (Figure 59). The loaded clamshell was placed on top of the 6-inch screen and opened. Donjon personnel used water hoses to rinse sediment and clay from the matrix while Atkins archeologists supervised the recovery of artifacts from the screen. Any artifacts larger than 6 inches (or otherwise visible in the sediment/shell hash matrix) were removed and placed in wet storage containers, labeled with the corresponding clamshell and grid number for provenience. The remaining materials were rinsed through the 6-inch screen to be collected on the underlying ¼-inch screen.

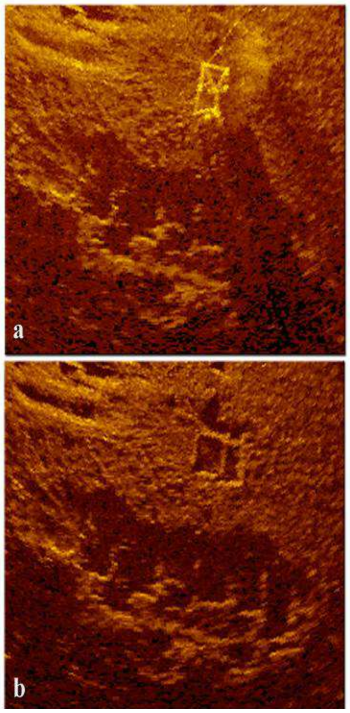

FIGURE 58. SECTOR-SCAN SONAR IMAGE OF CLAMSHELL OPERATION. (A) CLAMSHELL ON SEAFLOOR; (B) CLAMSHELL FOOTPRINT (SECTOR-SCAN CAPTURES BY SARA LAURENCE)

UXO/EOD specialists monitored each clamshell's contents, removed potentially live ordnance, and temporarily stored the ordnance in small water-filled containers. MEC recovered from the 6-inch screen were given a unique artifact number and documented (photographed and catalogued). At the end of each day, MEC were transported off site by the Navy EOD. Possession of MEC was transferred onshore to Marine EOD specialists who were responsible for rendering them inert. A portion of the San Jacinto Placement Area was selected for inerting MEC, as neighboring areas were sheltered by a surrounding earthen levee and a wide uninhabited space. At the San Jacinto Placement Area the shells, 18 total, were x-rayed by TEAM Industrial Services, Inc. to help identify internal features of the shells.

Marine EOD specialists utilized the x-ray images to determine the proper method to inert each shell. Shells were rendered inert by means of a remotely operated drill press and a pressure washer. Shells were submerged in a container of water, which was mounted to the drill press. A remote camera monitored drilling of a small hole into the powder chamber of each shell. The Marine EOD specialists were protected during this operation by a metal bunker behind an earthen berm. Once the powder chamber had been penetrated, the interior of the shell was flushed out with high-pressure water. The internal volume of each cleaned shell was measured to confirm that all powder residues had been removed, at which point the shells were certified by the Marines as inert and were turned back over to the archeologists for conservation.

To maintain provenience and prevent mixing of materials, all clamshell lifts from a specific grid were placed into a single filter box. The materials barge was able to transport up to nine filter boxes at any one time. Once the filter boxes were full, the materials barge was shipped overnight to the on-shore screening facility in Freeport, and a barge of empty filter boxes was returned to the site so that there was no interruption in clamshell operations. The clamshell recovery of artifacts ended on December 12 when it was perceived that complete coverage had been attained for each grid.

At the conclusion of the *Westfield* site recovery, the focus of the work shifted to the attempted removal of potential dredge hazards. The large crane barge was used for this operation and a large "orange-peel" grabbing device was attached to the crane for the retrieval of large objects (Figure 60). The barge was maneuvered over the locations of previously identified sonar targets in the

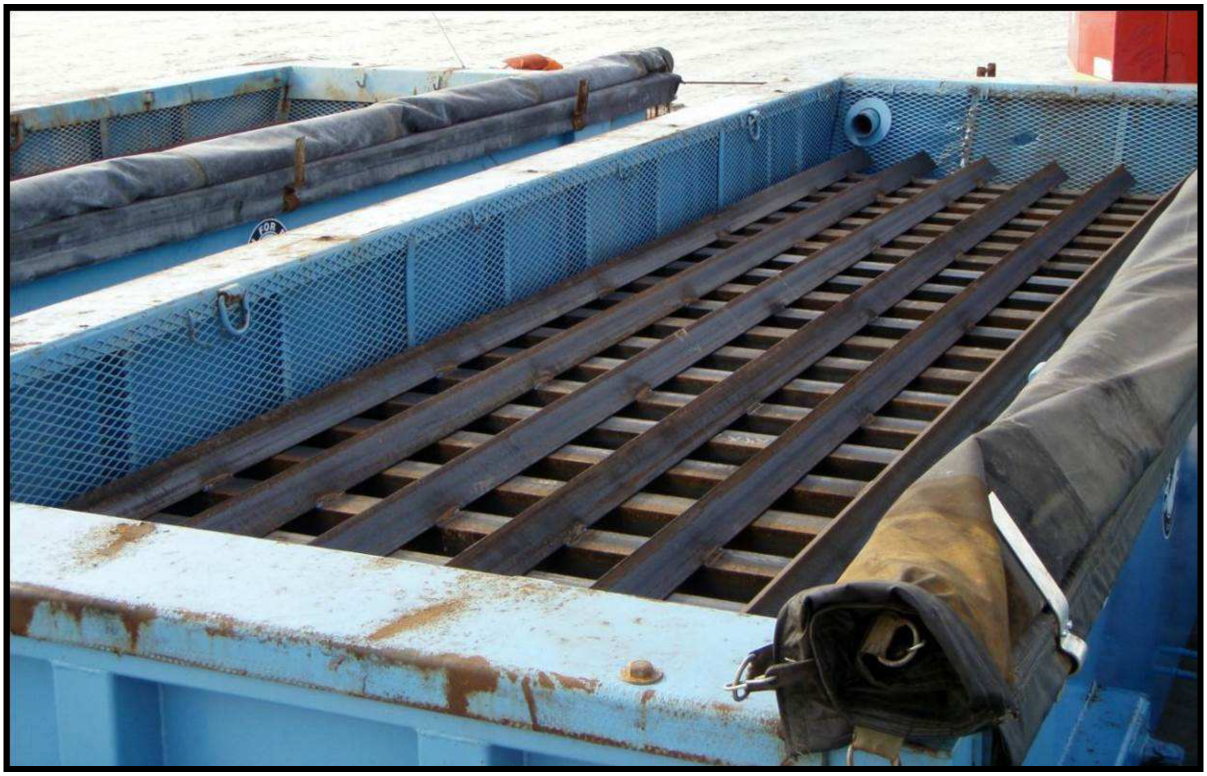

FIGURE 59. FILTER BOX WITH INSET 6-INCH MEC SCREEN INSERTED (PHOTOGRAPH BY SARA LAURENCE)

proximity of *Westfield* that were considered to be potential dredge hazards. This effort was augmented by the use of a sector-scan sonar to locate areas of visible debris. Included among the targets was M16, a magnetic anomaly and sonar target (Figure 60a) identified during the 2007 Galveston-Bolivar Causeway remote-sensing survey (Borgens, Hoskins et al. 2007). In 2007 M16 was recommended for avoidance or, in the case avoidance was not feasible, ground-truthing as its magnetic anomaly was similar to those of known historic shipwreck sites. Based on the sonar record, the source of the anomaly appeared to be several objects, 21.3 to 24.6 ft in length, that were located at a distance of approximately 109 yards from site 41GV151 and inside the southern boundary of the TCC. At the end of the May 2009 field season, the recommendation for M16 was changed to the archeological monitoring of its removal. Consultation between the COE, the Navy and the THC following the end of the clamshell operations, however, concluded that the work completed on the contiguous portion of the wreck was sufficient to meet Section 106 requirements for archeological clearance of 41GV151, and therefore archeological monitoring of the removal of nearby objects possibly associated with the wreck was no longer necessary. Archeologists were invited to monitor the efforts to remove potential dredge hazards on December 14 as a courtesy. Though 22 attempts were made at locations across the channel, only one object was retrieved through this effort; one of the two pipes visible on the sonar from M16. The recovered pipe was a section of concreted sewer pipe approximately 21.3 ft long (Figure 60b).

Screening and Cataloging

Cataloging and photo-documentation of the artifact collection in Freeport ran concurrently with the last third of the Galveston recovery effort. Sediment-laden filter boxes were transported by barge to J&S Contractors' marine yard in Freeport where the contents of each container were rinsed and screened by teams of archeologists. Artifact documentation commenced on December 3 and was suspended on December 15 (a total of 12 days excluding mobilization) following the conclusion of the Galveston fieldwork. The remainder of the artifact collection, over 350 containers, was transported to Austin where cataloging resumed on January 11 and continued for a duration of 27 days, ending on March 2. In total, the screened shell hash/sediment contained over 7,800 artifacts and concretions.

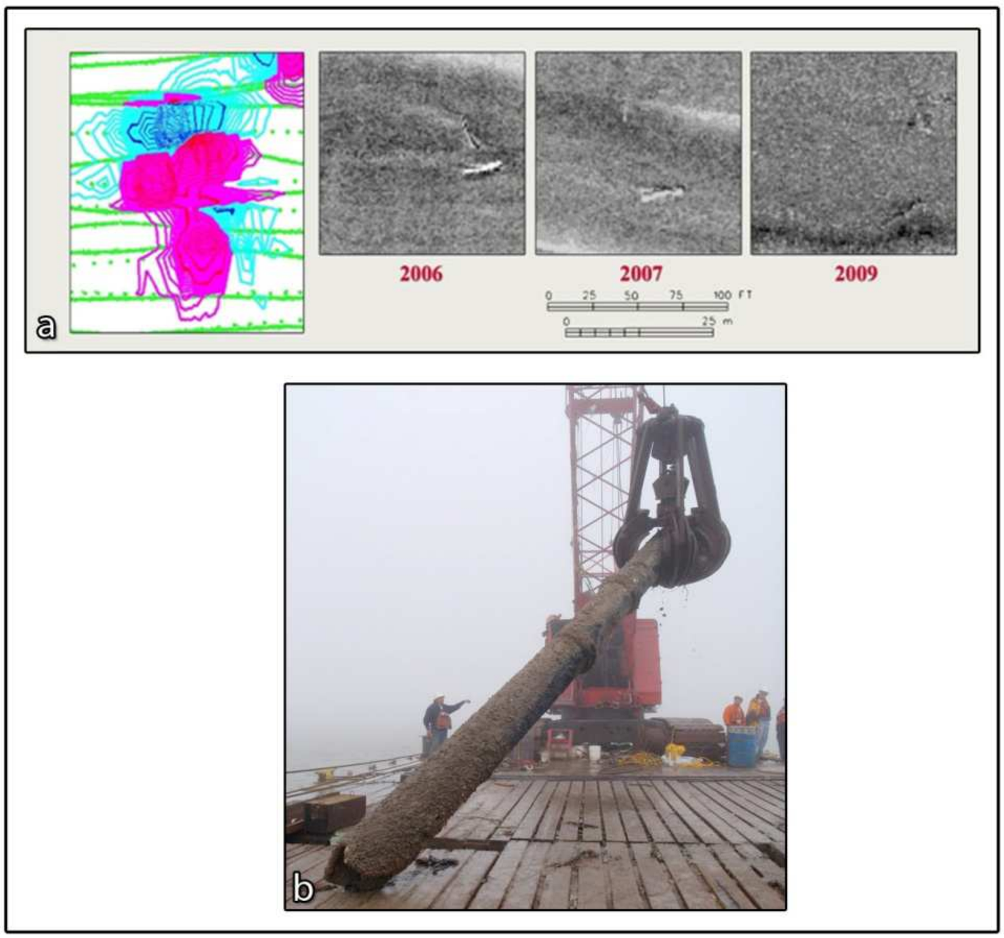

FIGURE 60: ANOMALY M16. (A) MAGNETOMETER AND SONAR DATA (BORGENS, HOSKINS ET AL. 2007); AND (B) REMOVAL OF MODERN PIPE SEGMENTS

Freeport Screening and Cataloging

Beginning on December 2, and occurring every 2 to 3 days, a barge of sediment-laden filter boxes was transported to J&S Contractors' marine yard in Freeport. The barges each contained up to nine filter boxes though the boxes were not always used for sediment. Some were used for wet storage of large artifacts. In addition to the filter boxes, artifacts removed from the 6-inch screen and stored in containers were also shipped to Freeport so they could be cataloged and documented. Once a barge arrived with new filter boxes, an archeologist in Galveston, usually Sara Laurence, would communicate to the field supervisor in Freeport (Amy Borgens) the corresponding grid numbers for each filter box. Dependent upon the clamshell schedule at Galveston, filter boxes could be either screened by archeologists while still situated on the barge or, in some cases, they were moved by crane onto shore for screening. A crew of four archeologists, including one crew chief, was assigned to each filter box. Each of the four crews would work within each box and would begin the process by using shovels to move the unscreened material to one side of the box. Each crew used two nested 3-x-5-ft screens of ½-inch and ¼-inch gauge placed in the center of the filter box (Figure 61). As sediment was screened, sterile material was collected in a pile and then transferred to 35-gallon waste containers. The duration of screening each box varied and was heavily dependent upon the amount of shell hash present; one filter box could take ½ day to 2 days to complete.

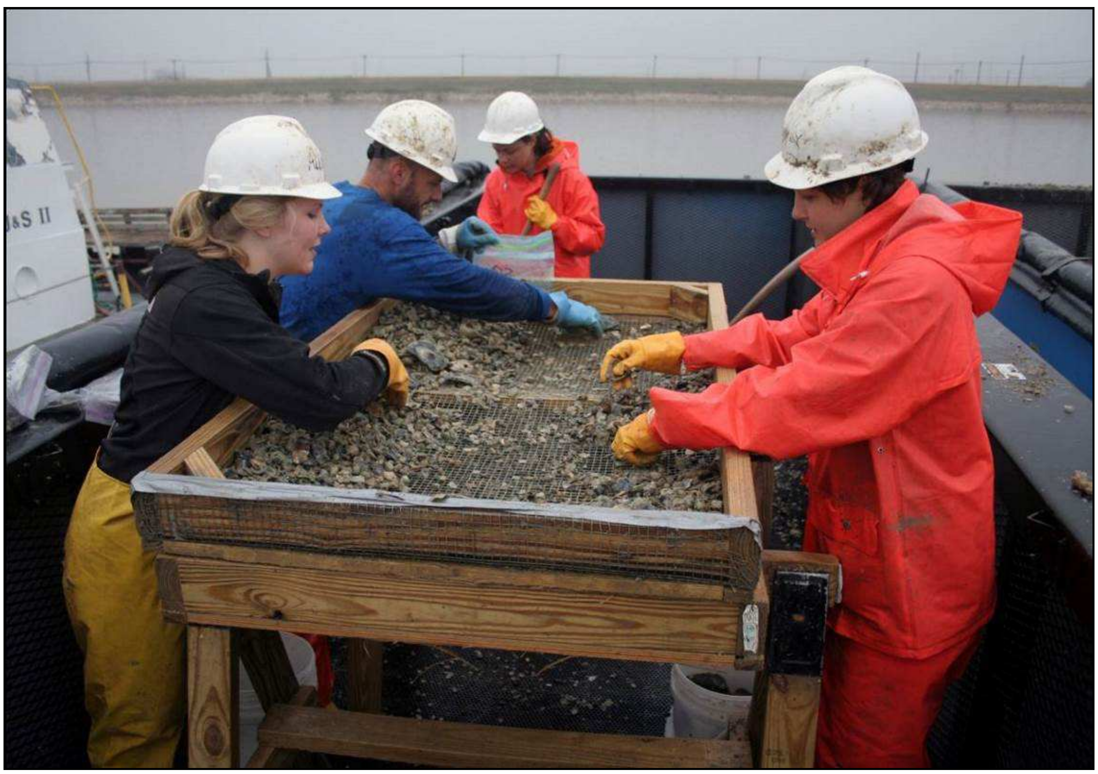

FIGURE 61. CREW SCREENING ARTIFACTS IN FREEPORT (PHOTOGRAPH BY AMY BORGENS)

Once artifacts were removed from the screens, they were placed in water-filled containers, usually 5- or 15-gallon sealed buckets. Each container was marked with the grid number and transferred to a holding area at the marine yard. A four-person cataloging crew, consisting of three catalogers and one photographer, systematically went through the containers and documented each artifact. Artifact documentation consisted primarily of making a quick sketch with basic dimensions and included notes that might allude to its identification or material type. Each artifact was photographed with a scale and label.

In addition to the smaller objects discovered during screening, several roll-off boxes containing large or heavy artifacts were shipped to Freeport from Galveston. These boxes transported items such as the bearing block, boiler flues, large metal plates, a large turnbuckle, and part of the engine cylinder, some of which were cataloged on-site in Galveston. Roll-off boxes also were used for shipping artifacts from Freeport to the CRL in Bryan, Texas. The major objective of the cataloging team in Freeport therefore was to catalog any large item that needed to be shipped in a roll-off box. Though the screening crews were producing hundreds of buckets full of smaller artifacts, cataloging initially focused on processing larger items that required more-specialized transport. Screening of all 42 grids was completed on December 13. On December 15 the remaining containers of uncataloged artifacts, approximately 360, were packed in a roll-off box in preparation for the trip to Austin. Artifacts were delivered and unpacked at the Atkins Austin warehouse on December 16.

Austin Cataloging

Cataloging of the remainder of the collection resumed on January 11. Eight archeologists from the fall field session were retained for the winter cataloging, in addition to Amy Borgens and Sara Laurence, and included seven catalogers and two photographers. All work conducted in the fall was in windy, rainy, cold conditions that created difficulty with record keeping as almost all work was performed outdoors. For the final phase of artifact processing, in a more controlled, albeit unheated, environment, artifact documentation was conducted in an "assembly-line" fashion.

The containers were first organized by grid number and documented beginning with grid 102 (artifacts were not recovered from grid 101). The contents of each container were emptied onto a screen to drain water from the artifacts. They were laid out on a table and sorted. Similar artifacts were grouped together and cataloged under the same lot number. Lot numbers were assigned according to the grid that contained the artifacts. For example, multiple cuprous nails would be grouped together as one number – such as lot number 103-50 which was 22 cuprous nails (with 103 denoting the grid number). Once an artifact or artifact group was assigned a number, it was moved into a water-filled container that was labeled to indicate the artifacts had not yet been cataloged. Once all the artifacts from a grid were sorted and given a unique identification lot number, the crew would begin sketching the objects and taking basic measurements (Figure 62). After the catalog form had been completed, the artifact was placed in another water-filled container that was labeled to indicate it was ready for photography. Each of the two photographers would photograph a minimum of one view of the artifact, unless it required more, and then store the artifacts by material type (i.e., ferrous, cuprous, organic) into water-filled 5-gallon buckets. Artifacts that were too large to be stored in 5-gallon buckets were placed in large tubs or stock tanks. This process was completed on a grid by grid basis until approximately 40 to 50 buckets (general shipment size) were completed. Each artifact catalog form was entered into a database and then compared against the photography, to eliminate numbering or labeling errors, prior to shipment to the CRL. Four artifact deliveries were made to the CRL in February and March 2010. A preliminary analysis of the artifact collection is presented in the following chapter.

FIGURE 62. SARAH WITTENAUER CATALOGING ARTIFACTS (PHOTOGRAPH BY AMY BORGENS)

Critique of Recovery Methods

Any archeological undertaking of this magnitude presents its own unique obstacles, and the USS *Westfield* investigations proved no different. Apart from the typical inconveniences of unpredictable weather and low-to-zero diving visibility that have hampered many underwater archeological projects, the single most significant barrier to the investigation of *Westfield* was simply the physical accessibility of the site. *Westfield* is located near the confluence of the Texas City and Houston navigation channels, which cross the Gulf Intracoastal Waterway 1 mile northwest of the site to form one of the busiest commercial shipping intersections in the world (McConville 2004, in Dellapena 2009; Morris 2009). Added to this complication were the daily tidal fluctuations that limited productive dive windows to only a few hours per day, and the unknown quantity of suspected unexploded and unstable naval ordnance that remained scattered across the site. The compounding risks that these conditions posed to both diver and surface-crew safety forced the USACE and Atkins, along with the consultation and cooperation of the NHHC and the THC, to adopt several nontraditional archeological excavation methods suited to the unique needs of the *Westfield* site. This chapter presents a summary and critique of those methods in an effort to provide a guide to archeologists and Federal agencies that may be faced with similar circumstances on future shipwreck excavations.

The most significant deviation from established archeological practice was the employment of a large electromagnet and an environmental clamshell dredge for the artifact recovery phase of investigations. These devices are not typically used within an archeological context; however, Atkins, USACE, Navy SUPSALV, and Donjon Marine worked diligently to adapt these tools for use on a historic site and were largely successful in recovering the artifact assemblage. Being a predominantly disarticulated artifact debris field with no hull remaining, this wreck site was more amenable for the use of such devices than would be the case for a wreck with an extant hull.

Atkins originally proposed to document *Westfield* using more-traditional underwater archeological techniques, including diver mapping and manual artifact recovery from a series of 10-x-10-ft grids established across the site (Borgens 2009a). Atkins tested this methodology in May 2009, but strong tidal currents and ship traffic in both the TCC and HGNC restricted work time and created dive safety hazards by periodically causing the dive boat to drag its anchors. As a means to facilitate fieldwork and ensure a safer dive environment, Atkins proposed a 24-hour crew rotation (encompassing two daily dive windows) from a semipermanent spud barge/dive platform positioned at the site and next to the TCC. Under this scenario, however, strong tidal currents would continue to limit diver bottom time at the site, greatly impede work progress, and would significantly prolong the fall/winter field session. It was concluded that the multi-month fieldwork required for diver mapping and recovery of artifacts would place both the divers and equipment at risk, due to weather and the extensive commercial and recreational vessel traffic inherent at that location.

Due to the safety risks to both divers and equipment at the project site, Atkins and the USACE investigated alternative nondiver methodologies for the removal of artifacts from the seafloor (Borgens 2009b). After a thorough review of these options, and through discussions with the USACE, NHHC, and the THC, the controlled use of a small clamshell device was selected as the safest and least destructive method for mechanical removal of the sediment matrix and small artifacts from the seafloor. The use of a clamshell at site 41GV151 was justifiable due to many site-specific factors including the lack of hull remains; deflation of the site into a 1.5-ft-thick strata; and the likelihood that spatial integrity of the site had been partially compromised by the magazine explosion, subsequent salvage, channel obstruction clearance, and erosion. This method also allowed archeological screening of the sediment (shell hash and silt) that would not be possible with the traditional archeological recovery that was initially recommended.

The use of clamshell buckets within an archeological context is not well documented. This methodology is largely associated with the work conducted by salvage organizations that have used these devices errantly on intact shipwrecks and that largely destroyed the archeological significance of the sites. It was the clamshell dredging and destruction of the late-eighteenth-century British warship HMS *De Braak* (in Delaware) that convinced the U.S. Congress to adopt the Abandoned Shipwreck Act in 1988 (Keith and Carrell 2009:122–123). In this particular example, cables were used to remove a 70-ft intact section of the hull, and much of the wreck and its contents dropped onto the seafloor. A clamshell was used to retrieve portions of the wreck, which were then dumped into a road construction rock sorter for sifting (Paine 2000:46–47). Situations such as these have made archeologists understandably hesitant to employ similar tactics on historic shipwreck sites. There are, however, some precedents for the use of such devices in excavations and archeological salvage projects. In 2007 a purpose-made clamshell (termed a Large Artifact Retrieval Tool [LART]) was used to remove a large concretion from an early-nineteenth-century deepwater shipwreck site in the Gulf of Mexico (Ford et al. 2008). During these operations, a very small section of the hull was accidentally recovered along with the concretion, which included a barrel containing scrap iron, a box of miscellaneous objects, bar shot, and spherical shot. The 1766 wreck of *Nuevo Constante*, off the coast of Louisiana, was clamshell dredged in 1980 by an offshore construction company. A report regarding the archeological investigation indicates the clamshell bucket primarily removed ballast and a quantity of artifacts resulting in minimal damage to the lower hull (Pearson 1981). It has been argued, however, that *Nuevo Constante*'s hull and almost all artifacts not considered treasure items, including cannon and anchors, were destroyed or discarded by the salvers (Keith and Carrell 2009:122). Both of these latter projects have been criticized for damage caused by the use of the clamshell bucket. In 2001, Panamerican Consultants Inc. investigated two Spanish-American War shipwrecks that were scuttled at the entrance channel to San Juan Harbor, Puerto Rico. Both vessels, *Manuela* and *Cristóbal Colón,* were cut into small sections with a modified 60-ft-long steel I-beam. A clamshell bucket was used first to remove sediment overburden from the site and later to recover the shipwreck sections. Hull pieces that were too large to be removed by the clamshell were manually attached by chains to a crane and lifted from the site. Archeologists documented key attributes of the hull and other diagnostic features (James et al. 2003:62-63). These examples demonstrate work that has been accomplished by bucket-dredging on intact and *in situ* shipwreck sites with good hull preservation.

Westfield was neither intact nor *in situ* in the traditional sense. After grounding on a sand bar and being blown up during the Battle of Galveston, *Westfield*'s remains were periodically dispersed through various salvage and navigation-hazard clearance operations. Creation of the Texas City Dike also resulted in nearly 40 ft of vertical erosion of the surrounding and underlying seabed, which, when combined with biological degradation of wooden remains, transformed the site into a large disarticulated artifact debris field lying atop Pleistocene clay amid modern shell hash.

Taking into account the combined physical and environmental conditions at the site, a consensus was reached among Atkins and all permitting Federal and State agencies to use the environmental clamshell bucket for recovery of sediment from the site of *Westfield,* solely because traditional archeological methods could not be safely employed. The decision was later made to precede the clamshell operations with use of a large electromagnet. This device was used over areas known from previous site investigations to contain potentially unexploded ordnance, in an attempt to safely and efficiently remove these objects so that they could be turned over to the supervising Navy and Marine EOD teams for off-site inerting, in advance of beginning the clamshell operations. Use of the magnet also had the ancillary benefit of being able to recover other large ferrous artifacts, without exposing them to damage from the clamshell and without having to manually separate them from a surrounding sediment matrix.

The clamshell and electromagnet operations were ultimately successful in allowing archeologists to safely complete a systematic and controlled excavation of the *Westfield* site. Each device, however, had inherent disadvantages that should be taken into consideration before applying a similar methodology on future excavations. Below is a brief list of the limitations and lessons learned from use of these methods.

Clamshell

- *Difficulty ensuring complete site clearance.*

  Though efforts were made to recover all of the artifacts within each grid, the clamshell was not successful at providing 100 percent clearance. Clearance of an area was determined by the supervising archeologist based on the quantity and type of material being recovered. If successive lifts recovered mostly clay, without significant amounts of sediment matrix and no visible artifacts, then the decision was made to move on to the next grid. Without a follow up diver or ROV search, however, it was impossible to be certain of an area's clearance. Several artifacts that were observed and recorded in 2006 (including a possible porthole) were not recovered despite repeated attempts at clamshell lifts in these areas. (A postrecovery magnetometer survey was conducted to determine the size and extent of any remaining artifact assemblage. The results of that survey are presented in Appendix E).

- *Difficulty ensuring placement accuracy of each clamshell lift.*

  When making each drop, the crane operator took into account the drift of the bucket caused by water depth and current, and made every effort to maneuver and position the clamshell at the desired location. ClamVision's horizontal positioning was necessarily tied to the end of the crane arm, however, and not to the submerged bucket. This discrepancy can be minimized by placing the bucket on the bottom, then removing all cable slack so that the bucket is directly underneath the recordable position of the crane arm. Differences in the ClamVision positioning and postlift sector-scan sonar imagery, however, show that this method is not completely accurate.

- *Potential for the clamshell to fail to completely close and seal.*

  The clamshell failed to completely close and seal 28 percent of the time, usually due to artifacts being caught in its jaws. Implications of an incomplete closure are that not all of the sediment and artifacts therein were recovered from that location. Although repeat lifts were conducted at the same approximate location in an effort to retrieve missed materials, artifacts smaller than the opening of the clamshell were possibly moved from their initial provenience by spilling into the mid-water column from the partially open clamshell. On several occasions, sediment was seen spilling out of the clamshell as it broke the water surface.

- *Potential for the clamshell to damage artifacts.*

  Though better than a traditional (nonenvironmental) clamshell, the environmental clamshell still had the capacity to damage artifacts, especially those that were caught in its jaws. New breaks were observed on several artifacts, and were often found on fragile objects like glass bottles.

- *Difficulty retrieving large, flat objects.*

  The clamshell has difficulty gaining purchase on an object laying flat to the seafloor, unless coincidentally being able to grip two edges of the object. On at least one occasion the crane operator observed a sudden weight change in the bucket's load scale, indicating that a large object had slipped from the clamshell jaws, but he was unable to relocate the object after repeated attempts. This is not to say that the clamshell is always incapable of retrieving these types of objects, as it was successful in retrieving the bottom of the firebox, which was flat and considerably larger than the dimensions of the clamshell. However, a successful recovery of these objects is highly dependent on the placement of the bucket, and the skill, observations, and communication of the crane operator.

- *Potential for redistribution of sediment and artifacts across the site.*

  Once the clamshell was emptied onto the 6-inch screen inside the filter box, sediment and artifacts would stick to the inside of the bucket, especially if the sediment had high clay content. This required the bucket be rinsed after every lift to avoid transferring sediment (and the artifacts therein) back to the site; however, rinsing was not always possible due to weather conditions. If it was considered unsafe to leave the bucket in place on the 6-inch screen (i.e. if the barges and crane were moving too much in the wind and swells), then the bucket was quickly returned to the site for the next lift without first being rinsed of residual sediment.

- *Potential for incomplete or inaccurate lifts.*

  Heavy currents sometimes caused the clamshell bucket to land on its side when it reached the seafloor, resulting in an incomplete lift, which would then have to be repeated. Heavy currents also affected drop accuracy. These issues can be somewhat reduced with a skilled crane operator, but only to a point.

- *Limited proveniencing of artifacts.*

  With the methods employed at the *Westfield* site, the provenience of artifacts was limited to either a 15–x-15-ft grid (for artifacts that passed through the 6-inch screen) or a 6-x-9-ft clamshell lift (for artifacts caught on the 6-inch screen). Proveniencing at this scale can affect the accuracy and interpretation of artifact distribution maps if a site is intact and *in situ*. In addition, this provenience is limited to the accuracy of the positioning system being used.

- *Vertical relief of site may increase risks associated with use of the clamshell.*

  Westfield was located on a flat section of the bay bottom with a sitewide elevation of approximately –48 ft USACE MSL. This meant that the depth of clamshell drops was constant and easily controlled (guide marks were painted on the crane cables so that the operator could ensure that the bucket was at the desired depth). Shipwrecks that are on a slope or at a nonuniform depth, or that have features extending up into the water column, are at increased risk of damage if the site elevations are not known for each clamshell drop location.

Magnet

- *Difficulty ensuring placement accuracy of each magnet lift.*

  As with the clamshell positioning, the location of each magnet lift was documented with ClamVision. This software did not take into account any position drift due to current, however, and was only capable of recording the location of the magnet as if it were directly below the crane arm.

- *Limited proveniencing of artifacts.*

  Provenience was only accurate to within the 5.5-ft diameter of the magnet's surface, which is further limited by the accuracy of the positioning system being used. Provenience of artifacts recovered with the magnet, however, is more accurate than of artifacts recovered by the clamshell, if only because of the smaller dimensions of the device.

- *Potential for the magnet to damage artifacts.*

  Damage to some artifacts was observed after the magnet was placed directly on the bottom, causing artifacts to bear some of its weight.

- *Depth of magnet's range below sediment unknown.*

  Artifact distribution data indicate that the magnet may not have always been able to collect all iron artifacts located within the magnet lift areas. Several iron artifacts were later recovered in the clamshell lifts overlapping these same areas. It is possible that the density of the sediment matrix prevented certain buried objects from contacting the magnet's surface, so that they could not be removed from the seafloor.

Though the above lists illustrate the limitations of using an environmental clamshell and electromagnet for artifact recovery at an archeological site, these methods were ultimately successful in achieving the intended results.

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7

ARTIFACT CONSERVATION AND ANALYSIS

Over 7,800 artifacts were recovered from the seafloor. Through the process of separating artifacts from concretion matrix, the number of artifacts ultimately increased to 8,380. A variety of material types were preserved on the site including iron (4,948), cupreous (2,134), organic (544 [385 wood, 41 coal, 69 bone/shell, 12 paper including 11 fuse wicks and a burned book fragment, 11 rubber, 9 rope/cordage, 6 fabric, 6 leather, and 1 mother of pearl button]), glass (299), lead (229), rock (150), brick (32), ceramic (26), silver (1), and a small number of unidentifiable material or concretion fragments. By far, the largest category was iron artifacts. The largest objects recovered from the site included a 9-inch Dahlgren cannon, a boiler firebox, boiler flues, and a bearing block from the walking beam.

CONSERVATION

With many underwater archeological projects, the task of documenting an extant shipwreck on the seafloor is often the abbreviated portion of the overall project. Organizing, labeling, and documenting 8,380 artifacts was a larger task, in terms of time commitment, than the actual recovery. The time needed for this effort, in turn, was dwarfed by the years required to conserve and stabilize the artifact collection for curation. Conservation of *Westfield* artifacts was conducted by Texas A&M University's CRL under a separate contract with the USACE from December of 2009 through early 2015.

Early in planning for artifact conservation, the three principal agencies having archeological oversight, the USACE, THC and NHHC, met with Atkins archeologists and staff of the TAMU CRL to agree upon the scope of this effort. It was apparent even prior to artifact recovery that many artifacts would be unidentifiable fragments that would offer little insight toward interpretation of the site. Other artifacts, in particular ship's fasteners, were expected in abundance. Conserving other than a representative sample of redundant artifacts, likewise, was considered to be a low priority. All parties were in agreement that the artifacts should be triaged by CRL staff early in their processing.

Five levels of conservation priority were established. Each artifact was assigned to a category based on the criteria listed below in Table 11. The artifact count shows how many individual artifacts are in each priority. Priority 1 artifacts and a representative selection of Priority 2 artifacts were conserved. Most Priority 2 and all Priority 3 artifacts will be reburied in a permanently wet environment. Priority 4 and 5 artifacts had their identifying tags removed and were deaccessioned.

A sample of artifacts was pulled from Priorities 2 and 3 for teaching purposes at CRL with permission of the NHHC.

A total of 2,834 Priority 2 and 3 artifacts will be placed in containers and reburied in a permanently wet marine environment. The location and disposition of the reburied artifacts will be curated with the collection of project materials at the Navy Yard in Georgetown, Maryland and with the Texas Archeological Research Laboratory in Austin, Texas. One Priority 2 artifact, the ship's firebox, was found to contain traces of mercury and will be disposed of in a hazardous waste landfill.

TABLE 11. ARTIFACT TOTALS BY PRIORITY

Priority 1: Unique, well-preserved, potentially-identifiable artifacts or best-preserved, representative, examples of identifiable, common artifact categories	1990
Priority 2: Redundant, well-preserved examples of identifiable, common artifact categories (example: a non-unique fastener); includes the firebox which was too degraded to conserve	1393
Priority 3: Fragment of identifiable, common artifact	1575
Priority 4: Fragment or mold of non-identifiable artifact	947
Priority 5: Non-identifiable concretion (no artifact or artifact mold present)	1368
Kept by CRL for teaching purposes (from Priority 2 and 3 but not part of above totals; included molds to teach students about casting and molding)	1107

A large portion of the collection could not be identified until it had been treated in the conservation laboratory. This was largely due to interactions between the artifacts and seawater. Artifacts recovered from saltwater environments, particularly those made of iron or other unstable metals, are commonly encrusted with thick layers of calcium carbonate, magnesium hydroxide, metal corrosion products, sand, clay, and various forms of marine life. The electrochemical corrosion of iron in seawater occurs through galvanic processes. This saltwater process is similar, though accelerated, to that which occurs in soil. Electrochemical corrosion of iron in seawater is five times faster than its corrosion in soil (Hamilton 1998b). Iron artifacts from saltwater environments are encased in this corrosion product, often called concretion or encrustation.

The USS *Westfield* artifact collection arrived at Texas A&M University's CRL in the spring of 2010. Prior to conservation, the artifacts were stored outdoors in large round bins, five-gallon buckets, or large metal storage containers. The buckets contained the small iron artifacts, in addition to cupreous, lead, and organic objects. These were stored in tap water or deionized water to begin the process of desalinization. Tap water filled the large bins which held the larger iron artifacts. A sequestering agent of 2-5 percent sodium hydroxide was added to the highest priority artifacts before and after the outer corrosion layers of concretion were removed. The largest artifacts, including the boiler flues and firebox, were stored in freight shipping containers filled with tap water.

Prioritization of the iron artifacts required conservators with extensive knowledge of the collection and of artifacts from underwater sites in general. Most of the small ferrous objects were prioritized from the x-ray alone, a process which required long hours of examination under the x-ray viewer. Categorizing larger artifacts was simpler; Priority 1 status was assigned to highly diagnostic or unique artifacts, well-preserved examples of a particular type of object, or objects selected for planned museum displays. The rest of the large artifacts were designated as Priority 2 or 3. In the winter of 2011-2012, the final prioritization decisions were made, and artifacts were sorted by priority. Each of the over 200 buckets were re-opened, and artifacts were checked against the database and photographs, before being sorted into a new bucket containing other artifacts of the same priority. At the same time, these buckets were condensed and filled to the brim, saving storage space at CRL and reducing the cost of reburial. The number of buckets was reduced from 200 to fewer than 85.

Each artifact's priority was documented in the artifact catalog and photographed. Initial cataloging and photography took place during and immediately following the excavation. The catalog forms recorded the basic measurements, a sketch, and a short description of each artifact. Pre-conservation photographs taken by Atkins were extremely useful as a quick guide for identifying artifacts that were mislabeled or had lost their identification tags. CRL conservators confirmed, prior to conservation, reburial, or de-accessioning, that diagnostic information on each artifact was recorded.

In addition to the catalog and photographs, radiographs were taken of the small iron artifacts to aid in the process of identification and prioritization. The majority of the collection consisted of iron concretions, or iron artifacts covered in disfiguring corrosion products. In order to prioritize these objects, an x-ray was taken to identify the iron artifact underneath the corrosion. Every concretion small enough to fit on the x-ray film, and not identifiable based on appearance, was x-rayed for identification. This was not necessary for the larger or non-ferrous artifacts, due to the lack of thick corrosion products obscuring the artifact underneath. Slightly less than half of the entire collection (3,612 artifacts) was composed of amorphic unidentifiable concretions that required radiographic analysis. Organized by date taken, the x-ray numbers were listed in the database for easy access. X-rays for Priority 1 artifacts were digitally photographed and available on a computer for quick reference.

The outward appearance of a concretion is often deceiving as to its internal contents. Figure 63 compares the photograph of a *Westfield* concretion, Artifact no. 107-14, with its radiographic image. The x-ray of this artifact revealed what was initially thought to be an oarlock. Later comparisons with historic photography, suggested instead that it might be a breech rope guide from a gun carriage. When the artifact was finally removed from concretion, the latter identification was substantiated. Because of its location within the site, it is possible this artifact came from one of the Dahlgren carriages on the aft deck.

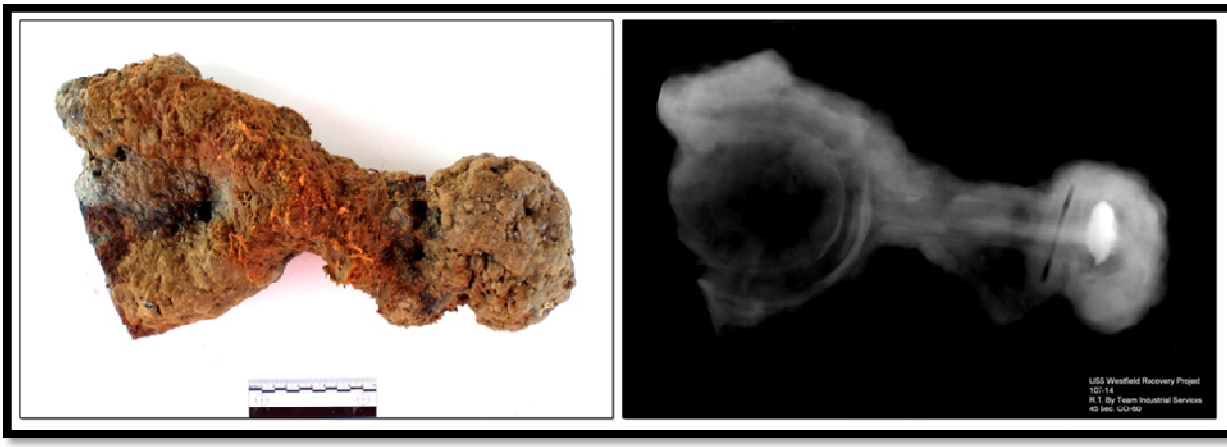

FIGURE 63. ARTIFACT CONCRETION AND CORRESPONDING RADIOGRAPHIC IMAGE (ARTIFACT 107-14; PHOTOGRAPH BY KIRSTEN ATWOOD)

Artifact cards detailed each artifact's conservation and included a short description and measurements, treatment plan, and associations with other artifacts. During conservation, in-progress photos were taken to record the conservation process and to identify artifacts after the concretion was removed. Following conservation, every artifact was photographed with a scale and lot number. All data and photographs are stored on CRL computers and copied on backup external hard drives.

With a collection of over 8,000 artifacts, organization was a high priority. Artifacts were cataloged in a Microsoft Excel database organized by lot number. The database included information on the location or status, count, and material of each artifact, as well as a short description, important notes, and priority category. The database proved a useful tool as the artifacts could easily be sorted by each of these categories. The location or status category aided in locating a specific artifact, directing the conservator to a specific location in the laboratory or showing that the conservation was either in progress or completed. The challenge of keeping the database updated required cooperation from all of the lab's conservators and constant maintenance. A thorough technical discussion of *Westfield* conservation methods has been published in a Master of Arts thesis by Jessica Stika (2013), one of the contributing authors of this report. Treatments used by CRL staff are described below for the most abundant artifact categories based on excerpts from Stika (2013) with permission.

Treatment of Iron Artifacts

Iron comprises the majority of artifacts (59 percent) preserved in the collection of USS *Westfield*. The iron machinery, including the boiler and firebox, and the plates that lined the outer hull, comprise a significant portion the finds in terms of weight and size. The *Westfield* artifact assemblage includes both cast iron and wrought iron. Wrought iron is essentially pure iron, containing less than 0.2 percent carbon by weight, in the form of slag inclusions. The slag is beaten out of the iron as much as possible while the metal is worked in the forging process. The slag corrodes along the contact surface with the iron, causing longitudinal striations which have the appearance of wood grain. Cast iron contains a larger percentage of carbon, approximately 2-6 percent by weight, than is found in wrought iron. As cast iron corrodes in sea water, the outer surfaces undergo graphitization, which causes the artifact to lose density and mechanical strength. The graphitized zone has a very light weight and is very unstable, which can cause this outer zone to rapidly break down after excavation. Because cast iron's complex nature, it is much more difficult to conserve, being more sensitive and time-consuming than wrought iron (Pearson 1987:77,79; Hamilton 1996:46; Cronyn 2001:176,185; Selwyn et al. 2001:110; MacLeod 2002:706).

Conservation treatments of cast and wrought iron have two goals; to lower the concentration of chloride ions and reduce the iron ions to magnetite in order to preserve the greatest amount of iron, and more importantly, to preserve the original surface in the corrosion layers. Two primary treatments applied to marine iron artifacts, alkaline sodium sulfite and electrolysis, can effectively accomplish those goals. However, different problems are encountered with the treatment of cast iron versus that of wrought iron (Stika 2013). The alkaline sodium sulfite treatment is primarily used for cast iron but is applied to wrought iron as well. The purpose of this method is to increase the porosity of the iron in order to increase the rate of chloride release and harden the graphitized zone of cast iron. The treatment is most applicable to small, cast iron artifacts that still contain an iron core, which would otherwise disintegrate during treatment (Hamilton 1996:79-80).

Many of the larger cast iron artifacts were successfully treated using electrolytic reduction. These objects were treated in baths of 2 percent sodium hydroxide, in either mild steel or heavy plastic vats to undergo electrolytic reduction. Electrolysis effectively increases the diffusion of chlorides and causes the reduction of iron corrosion to magnetite. An electrolytic cell was created, using a power source to supply the electric current, with the artifact acting as the negatively charged cathode to which positively charged iron ions travel and a mild steel mesh positively-charged anode to which electrons travel. Reduction takes place at the cathode and oxidation at the anode. The conservator adjusts the applied electromagnetic field which controls current density (Hamilton 1996:56-60). Lower currents prevent corrosion, called cathodic desalting. When the current density is increased, the reduction of iron oxyhydroxides and iron oxychloride to magnetite occurs and releases chlorides. The magnetite is less dense and more porous, allowing for the diffusion coefficient to increase which decreases the amount of treatment time (North and Pearson 1978:30-31; Cronyn 2001:199). The diffusion of chlorides is measured using the mercuric nitrate test described by Hamilton (1996:60-62). The chlorides, measured in parts per million, are recorded weekly until they are at a minimal level, commonly below 50 parts per million.

The majority of wrought iron artifacts excavated from *Westfield* were preserved in a transition phase. These artifacts generally consisted of partial metal cores surrounded by voids where the original metal had ozidized, and then migrated to the outer surface, creating a dense concretion mixed with marine growth. Difficulty arose in conserving artifacts for which the original surface was completely converted into corrosion products surrounding an iron core. In such cases, the cavities were filled with epoxy resin gradually as they were cleaned. Once the concretion was removed, the half-epoxy, half-wrought-iron artifact was again molded and then recast to create an entirely epoxy cast. This complete epoxy cast was necessary because the iron would continue to corrode and eventually separate from the epoxy sections.

Cast iron artifacts generally retained their complete shape without voids in the concretion; however, much of the outer metal had converted to a graphitized state. This left the outer features of the artifact intact but fragile. Often, immediately after removing the marine concretion, the graphitized layers of the artifact began to break off of the surving inner metal core. To retain the original shape of the artifact, fragments that broke off were glued back into place, and then the entire artifact was molded and casted. This process was necessary for most smaller cast iron artifacts.

Some of the smaller cast iron artifacts that were less graphitized, did not require molding and casting. These cast iron artifacts were treated using sodium sulfite. First, concretion was cleaned mechanically from the artifacts' surfaces. They were placed in an airtight container with 0.5 Mole (M) sodium hydroxide and 0.5 M sodium sulfite with deionized water. Three consecutive treatments, six weeks in length, were used to effectively remove the chlorides. Following the treatment, the artifacts were rinsed in baths of deionized water, coated in tannic acid, and sealed in a layer of microcrystalline wax (Hamilton 1996:77-88; Donny Hamilton 2013, personal communication).

Cast iron artifacts undergoing electrolysis were drilled so that a screw could be inserted and attached to the inner iron core. An experiment conducted by Stika (2013) reaffirmed the need for establishing a direct electrical connection to the iron core in order to improve the outcome for artifacts sturdy and large enough to be drilled. If a direct electrical connection is not established with an iron core, electrolysis can result in disintegration of the graphitized layers. This treatment was successfully conducted on several large pieces of the engine cylinder allowing concretion layers to cleave off easily during mechanical cleaning without spalling of the graphitized outer surface. After treatment, perforations caused from drilling were filled and sealed with wax, obscuring the marks.

Following electrolysis, the artifacts were washed in three consecutive baths of boiling deionized water. After the final bath and while still hot, the artifacts were painted with tannic acid and allowed to cool. Tannic acid is applied again in two coats before the artifacts were coated in microcrystalline wax to seal the iron from the surrounding environment. Hamilton (1996, 1998b) and Cronyn (2001) are recommended for a more detailed explanation of electrolysis methods.

Treatment of Cupreous Artifacts

Cupreous artifacts are the second most common artifact material (26 percent) recovered from Westfield. Copper's corrosion rate decreases when the copper undergoes galvanic coupling with iron, and many copper artifacts from Westfield were found encased in iron concretion. As a result, only a small amount of copper corrosion products were found on the cupreous objects. Treatment began with the removal of corrosion products mechanically, with tooth brushes and pneumatic chisels for larger deposits. The copper artifacts were treated with electrolytic reduction in a solution of 2 percent sodium hydroxide, with mild steel mesh as the anode. The artifacts were then placed in three baths of boiling deionized water and polished with sodium bicarbonate to remove any residual corrosion products (Hamilton 1996:92). Following polishing, the artifacts were immersed in a 2-percent solution of benzotriazole (BTA), which inhibits corrosion by forming a stable polymeric coating that seals the copper from the atmosphere, effectively stopping any cathodic or anodic reactions from occurring. A coat of microcrystalline wax or Krylon spray is added as an additional sealant to ensure the artifact is completely sealed from the surrounding environment (Pearson 1987:237).

Treatment of Lead Artifacts

Lead artifacts comprised 3 percent of artifacts recovered from the site of *Westfield*. Many of these were badly eroded by mechanical weathering. In seawater, lead is less susceptible to corrosion than iron or copper. Lead corrosion products consist of lead (II) sulfate ($PbSO_4$) and lead chloride ($Pb(OH)Cl$). Lead sulfate creates a coating that passivates the metal and impedes further corrosion. When exposed to seawater, a thin, white layer may form, composed of cerussite, or lead carbonate, and hydrocerussite, or basic lead carbonate, which crystallizes and protects the lead. This layer was occasionally observed on artifacts excavated at the *Westfield* site.

While the corrosion products on *Westfield* lead were stable, the lead was cleaned mechanically using tooth brushes and dental picks, careful to avoid scratching the soft surfaces of lead artifacts. Hydrochloric acid (1 M HCl) was also used to clean the lead chemically, removing any carbonates or organic debris on the surface (Pearson 1987:243-244; Hamilton 1996:104; Cronyn 2001:202,204). Lead can be dissolved in 'soft', or deionized, water, so the HCl was mixed in tap water and the lead rinsed in tap water following treatment (Pearson 1987:244; Hamilton 1996:104). After rinsing, the lead was left to air dry and coated in microcrystalline wax to protect the artifacts from the surrounding environment and to make them safe to handle for analysis (Hamilton 1996:106).

Treatment of Ceramic Artifacts

The ceramics from the site of *Westfield* (0.3 percent of the collection) consist of fragments of whiteware, ironstone, stoneware, and porcelain. Calcium deposits and iron corrosion covered the surfaces, occasionally surrounding the fragment completely. In addition, surface damage included abrasion from the environment and flaking due to salt crystallization (Pearson 1987:99-101). Prior to conservation, the ceramics were stored in deionized water to remove any salts. Most fragments had corrosion products or marine life that was cleaned mechanically using a toothbrush and dental tools. If staining was present, the ceramics were placed in a solution of 10 percent hydrochloric acid in tap water in conjunction with mechanical cleaning. If the hydrochloric acid failed to remove the stain, a solution of 10 percent oxalic acid in deionized water was used to remove the remaining stains.

Following concretion and stain removal, silicone oil was used to treat the ceramics from *Westfield.* Silicone oil bonds with the surface of the ceramic, creating thin layers of protection. Silicone atoms form chains by bonding with oxygen atoms through polymerization. A catalyst cross-links the bonds to form chains that lock into place around the artifact. The silicone oil is made of various molecular weights that produce different results. Different combinations of silicone oils and cross-linker percentages are used on a variety of materials to produce different results, depending on aesthetic considerations (Helen Dewolf 2011, personal communication).

After the ceramics were rinsed in tap water and deionized water to remove the acids, they were placed in dehydration baths. The fragments were placed in each bath for a period of two weeks. Dehydration is necessary to remove all traces of water before being placed in silicone oils. When mixed with water, silicone oil forms silicone rubber which is very difficult to remove from the surface of the artifact. Once dehydrated, the fragments were placed into a solution of 85 percent silicone polymer, made up of 66 percent SFD-1, 34 percent SFD-5, and 15 percent methtrimethoxysilane (MTMS) cross-linker. This was placed under a vacuum to facilitate the replacement of acetone with the silicone oil. The vacuum was increased then decreased slowly at regular intervals to ensure all the acetone was removed and the ceramic fragments were not damaged. Following removal from the vacuum, the ceramic fragments were allowed to drain before exposure to dibutyltin-diacetate (DBTDA) vapors. The DBTDA vapors act as a catalyst, which links the silicone polymer chains and creates the silicone oil layer around the artifact.

Treatment of Glass Artifacts

Glass from *Westfield* was fragmentary and often non-diagnostic. Most glass recovered from the site was deposited long after *Westfield* sank, and the modern intrusive glass was not treated. Glass consists of silica, alkali or soda ash and potash, and flux or lime, used as a stabilizer. By the 19th century, glass formulas became more stable than in previous centuries. Impervious to salts, 19th-century glass generally only suffers from devitrification when found in salt water environments (Hamilton 1996:22). As the glass is exposed to salt water, sodium and potassium hydroxides enter the silica structure of the glass and produce hydrated glass. This forms thin layers of glass which are easily spalled or eroded and provide access for the hydroxides to the body of the glass. Gradually, the glass becomes opaque and breaks down (Pearson 1987:101-102). Therefore, the conservation of glass requires consolidation similar to ceramic artifacts. While *Westfield* glass did not exhibit delamination, as generally only seen on 17th-18th century glass, to protect the fragments from further damage, the glass underwent passivation polymerization and catalyzation. The silicone polymer coats the glass to consolidate and bond with the surface, creating a layer that stops devitrification (Smith 2003:96, 98). The glass was treated in the same way and at the same time as the ceramics described above.

Treatment of Organic Artifacts

Well-preserved organics are typically unique to underwater archeological sites. The term organics envelops many types of materials, and the properties of each type need to be considered before conservation begins. Successful conservation of organics is measured by how close the final results resemble the original appearance (Pearson 1987:122). Conservation methods for organic artifacts from the site of *Westfield* are unique because of the large amount of iron present on the site which caused many of the organic artifacts to exhibit iron corrosion. The conservation methods focused on treatment using silicone polymers, while individual cleaning methods varied.

Wood

Very little wood was found at the site of *Westfield* relative to the amount of wood that was used in the ship's construction. Wood artifacts comprised about 5 percent of the assemblage. Most fragments are small and impregnated with corrosion products. A number of wood fragments exhibited evidence of fasteners, primarily bolts. The proximity of the wood to corroding iron preserved the fragments but also made their conservation more difficult. Due to the small size of *Westfield* wood fragments, a silicone polymer treatment was used.

Upon arrival at the CRL, the waterlogged wood, along with other organics, was stored in covered containers, the covers preventing biological growth before treatment. Conservation began with mechanical cleaning using pneumatic chisels and tooth brushes. Pneumatic chisels were used frequently due to the large amount of concretion present on most of the wood artifacts.

Iron corrosion imbedded in the wood was removed using baths of dibasic ammonium citrate, a chelating or sequestering agent. A 2-percent ammonium citrate treatment was chosen to treat the iron impregnated wood. EDTA is the most commonly used chelating agent in conservation and was a viable option; however, an EDTA solution can cause the wood to soften after prolonged exposure greater than 24-36 hours. In contrast to fast treatments in strong solutions, repeated, lengthy baths in weaker solutions, such as 2 percent ammonium citrate, are more effective and more easily monitored (Pearson 1987:127,195,244; Stambolov 1968:45). The higher selectivity of ammonium citrate is more efficient due to the reduced destructive secondary reactions and effects (Chartier 1991:73-75).

Once the iron corrosion products were removed, the wood fragments were placed in dehydration baths, similar to the ceramics and glass. However, the wood was placed in each bath for a longer period, six weeks instead of two for the ceramics and glass, to ensure complete replacement of the water with acetone. After dehydration, the wood artifacts are transferred into a silicone oil polymer in order for the acetone to be replaced by the polymer. Wood cannot be placed in a vacuum to facilitate the replacement of acetone with silicone oil, because wood has a tendency to change shape when placed under a vacuum, due to the collapse of cellular walls (Helen Dewolf 2011, personal communication). Excess oil is removed with a MTMS before a catalyst is used to crosslink the polymer chains. (Smith 2003:23-25). The same percentages of silicone oil and MTMS that are used for the ceramics and glass were used to treat the wood artifacts.

Rubber

The use of rubber in ship construction began in the 19th century, and the use of vulcanized rubber was widespread by the 1860s (Grieve 2009:677). Ozone, formed in the air through electrical charges, can promote oxidation of rubber; therefore, artifacts made of rubber must be kept away from electrical equipment. Rubber artifacts should be stored in a material such as cardboard that is equally susceptible to ozone and, therefore, can absorb ozone molecules before they reach the rubber (Mills and White 1994:115).

Rubber artifacts from *Westfield* did not show any penetration of iron and cupreous corrosion products; however, staining was frequently encountered. Rubber gaskets were found on the site of *Westfield* in association with iron hatches. The salt water environment and iron corrosion resulted in damage around the edges; however the gaskets were well preserved relative to other *Westfield* artifacts. The gaskets were mechanically cleaned to remove corrosion products and dehydrated before being treated in the same way as the ceramics, glass, and wood, using a silicone polymer. Because exposure to ultraviolet rays actually helps the polymer catalyze, the silicone can absorb ultraviolet light that would otherwise harm the rubber underneath (Helen Dewolf 2011, personal communication).

Leather

Leather conservation is very subjective, based on appearance, flexibility, shrinkage, and hygroscopicity, or the leather's ready ability to absorb water. Like other organic artifacts, stained leather must first be cleaned using both chemical and mechanical techniques. In many cases, the leather staining is not treated, as attempting to remove the stains is more detrimental to the leather artifact as a whole. The small leather fragments found with *Westfield* were treated in silicone oil in the manner described for the various artifacts above. They were placed in ten dehydration baths for six weeks each, treated with silicone oil and MTMS in a vacuum, catalyzed using DBTDA, and cleaned of excess polymer. Treatment of leather with silicone can restore flexibility and color approaching that of the original material.

Bone

Bone is both hygroscopic and anisotropic, so all salts must be removed before drying to prevent splitting and cracking. Salts can be easily removed through subsequent baths of tap water and deionized water until the salt content is minimal. Bone artifacts from *Westfield* were treated similarly to other categories of organic artifacts. After dehydration as described above, the bone fragments were conserved using silicone polymers. The bone was transferred from 100 percent acetone into silicone oil and MTMS, placed in a vacuum, and removed from the silicone oil and catalyzed with DBTDA. Excess polymerized silicone oil is removed with MTMS (Smith 2003:112-118).

Textile

Very few fragments of textiles were preserved on *Westfield*. Iron corrosion played a large role in their preservation, either preserving individual fibers or impressions of the textile fragments. Textile artifacts from *Westfield* are small and fragile. Cleaning and removal of the corrosion products on any of the *Westfield* examples would cause the fibers to pull apart and lose their shape. The use of silicone oil treatment allowed the fibers to be conserved prior to cleaning. Textiles were placed directly into the dehydration baths without the removal of the concretion that holding the fabric together. After dehydration, the textile was placed in silicone polymer, removed and catalyzed, and cleaned with MTMS. The silicone oil coated the concretion particles, allowing them to be easily cleaned off after the treatment. In their conserved state, the textile fibers were strong enough to be thoroughly cleaned and preserved (Helen Dewolf 2011, personal communication). For artifacts that contained only an impression of a textile, casts of the impressions were made to preserve the shape of the fibers using RTV adhesive.

ARTIFACT ANALYSIS

An assemblage of at least 7,800 artifacts was recovered in 2009. The conservation process discovered additional artifacts as concretions were dissected resulting in a final tally of 8,380. Artifacts recovered from the site represent a variety of forms, functions, and materials including iron (4,948), cupreous (2,134), organic (544 [385 wood, 41 coal, 69 bone/shell, 12 paper including 11 fuse wicks and a burned book fragment, 11 rubber, 9 rope/cordage, 6 fabric, 6 leather, and 1 mother of pearl button]), glass (299), lead (229), rock (150), brick (32), ceramic (26), silver (1), and a small number of unidentifiable material or concretion fragments. Of these numbers, 1,990 artifacts were conserved. The criteria used to select artifacts for conservation is discussed in the previous section. Illustration of every artifact conserved would be redundant and impractical for the purposes of this report. However, many of the most instructive artifacts have been selected for illustration to accompany the following discussions. The scale bar used in each of the following artifact figures is marked in centimeters (cm) except where otherwise noted in the caption as millimeters/centimeters (mm/cm), centimeters/decimeters (cm/dm) or only decimeters (dm). It is appropriate to express artifact dimensions in the units used by the makers of those artifacts, thus imperial dimensions are stated in the text below without metric equivalents. The authors regret any inconvenience from the fact that artifact photography utilized metric units.

Ship Construction

The combined destructive forces of the magazine explosion, fire, salvage, demolition, and years of erosion and exposure to the sea environment have eliminated any vestige of the former hull or superstructure. Few elements of the ship's architecture remain intact; however, certain artifacts can be used to infer details of *Westfield*'s construction. An outer protective armor of iron boilerplate was one of the most defining attributes of *Westfield* in its naval configuration. The vessel's low profile and iron plating gave the impression that *Westfield* was an ironclad (Scharf 1887:506). The depiction of *Westfield* in the 1862 Memphis sketch (see Figure 3) suggests the gunboat was plated with armor for most of its 225-ft length. Iron boilerplates, like those depicted in the drawing and described in the Copeland and Howe proposals (see Chapter 2), were recovered during the later Confederate salvage of the wreck site in May 1863. The Engineer Department of the Confederacy recovered 3,300 tons of iron boilerplates, valued at 60 cents a ton (Appendix A-2, letters 7 and 18).

The quantity of metal plate and plate fragments constitutes one of the larger categories of artifacts recovered from the site. Over 590 plate fragments were identified, though most of these related to the boilers, which were constructed from the same type of plates. Conservators were able to distinguish between the two plates types based on how they were fastened at their edges. Plates used in boiler construction were heavily riveted at the seams. Plates used as hull armor were individually bolted to the bulwarks.

Six boilerplates used as armor were recovered relatively intact (Artifacts 102-006, 108-001, 111-001, 111-002, 111-003, and 122-045). Their sizes varied by a few inches due to corrosion along the plates' edges; however, the most intact plate (Artifact 108-001), measured 5.0 x 5.0 ft, allowing the original size to be determined (Figure 64). This size is consistent with the size of plates covering the cabin in the Memphis drawing of *Westfield* (Figure 3). Conservators determined that the plates were originally 5/16-inch thick, sufficient only to protect the gun crews from small arms fire.

Fore and aft of the cabin (Figure 3) eight broadside gun ports were designed to be opened and closed as required by the numbers and positions of guns at any given time. Each gun port was 5.0 ft wide and was closed by means of a3-ft-tall upper plate hinged to a fixed lower plate covering the 2-ft-high bulwarks. When the plate was folded down on its hinges, opening the port, a cannon could be rolled out over the bulwarks. Similar hinged plating can be seen in a photograph of USS *Satellite* (Figure 5).The dimensions of the gun ports have been substantiated by recovery of a nearly complete 5.0 x 3.0 ft hinged armor plate (Figure 65). The hinges did not survive; however, fastening holes indicate that four hinges were used. Impressions in the concretion and staining on the iron indicate that each hinge was 14 x 2.5 inches long, affixed to the plate by three small bolt fasteners, 0.5-inch diameter, and spaced 3.8 to 4.5 inches apart.

FIGURE 64: SQUARE ARMORED PLATE (ARTIFACT 108-001; SCALE CM/DM)

FIGURE 65. HINGED ARMORED BROADSIDE GUN PORT PLATE (ARTIFACT 102-001; SCALE CM/DM)

FIGURE 66. ARMOR HINGE (ARTIFACT 107-075; SCALE CM)

FIGURE 67. STANCHION SOCKET (ARTIFACT 103-074; SCALE CM)

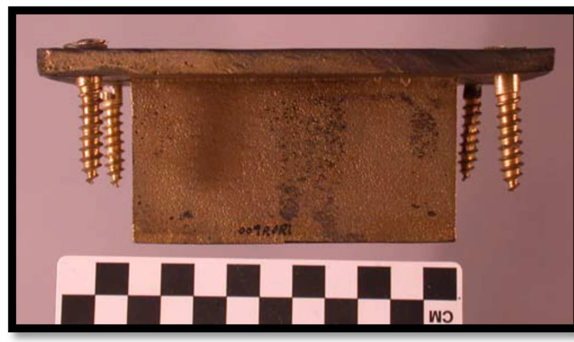

FIGURE 68. STANCHION SOCKET FROM USS *OTSEGO*

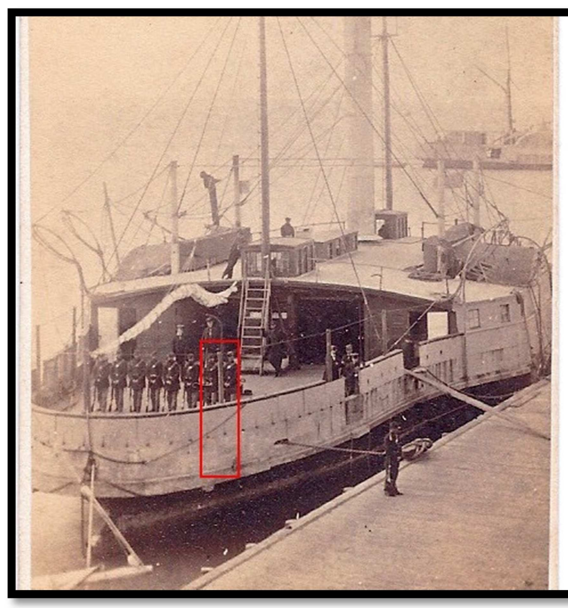

FIGURE 69. STANCHIONS FOR NETTING ON UNKNOWN FERRY GUNBOAT (COURTESY OF STEVE MEADOW FROM WAROFTHEREBELLION.COM)

The Memphis drawing (Figure 3) depicts that the gun decks at the bow and stern, were protected by smaller hinged metal plates. In the drawing these are clearly shown as less than half the width of the 5-ft plates protecting the cabin. These smaller plates could be raised or lowered as required when using the pivot guns. Artifact 123-037 and 125-001 are the best preserved examples out of five that were identified conclusively as the smaller size of hinged armor plates (Artifacts 103-076, 110-002, 110-003, 123-037, and 125-001). These plates measure approximately 3.0 x 2.5 ft. Their height indicates that when folded down, 2 ft of the armored bulwarks remained standing as shown in Figure 3 for both the broadside gun ports and the pivot gun positions. Hinges were preserved on several of these plates. Hinge measurements are consistent with those used on the broadside gun port plate (Figure 65). Numerous hinges also were found separated from the armor plates, often with their upper and lower components. Figure 66 displays some of these examples with their original pivot bolts still intact (Artifacts 103-075, 104-015, and 107-075).

Behind the bulwarks *Westfield* was equipped with defensive netting to repel enemy boarding parties. The Memphis drawing (Figure 3) shows netting supported by stanchions on both the bow and stern decks. These stanchions were supported by sockets imbedded in the deck. One of these sockets survived intact (Artifact 103-074). The artifact is cast iron and still contains some of the wood from the original deck (Figure 67). Based on the socket size, the stanchion measured 2-1/2 x 3-3/4 inches thick at the bottom of the socket. A similar stanchion (Figure 68) was recovered from the Civil War steamer, USS *Otsego*, the difference being that the latter object was made of brass and contained smaller measurements (Diveley 2008:223). *Westfield* required numerous posts and sockets in order to support nets around each gun deck. A general idea of the socket arrangement can be inferred from Figure 69, in which an unknown converted ferry gunboat has all of the stanchions erected in their respective sockets.

The ferryboat configuration of *Westfield* had seven large cabin windows on each side of the paddlewheel boxes. One or two of these windows on each end illuminated open, covered foyers between the cabin and the outside decks, while the others supplied light to the large passenger cabins. Cabin windows were removed when *Westfield* was converted from a ferryboat to a gunboat. The saloon deck was replaced with an open hurricane deck, and the cabin height was shortened by about 2 ft. The foyers were completely removed, creating longer fore and aft decks. The foyers windows disappeared and the remaining windows were removed, boarded up, and replaced with portholes.

During this period, sash weights were commonly used to counter balance the weight of large windows. This helped keep them open and prevented the windows from slamming down when being closed. Archeologists recovered numerous sash weights from *Westfield* (Figure 70). These weights may have been left over from when the vessel served as a ferryboat. During the rushed conversion of *Westfield*, and the removal of the large windows, many of the sash weights may have

FIGURE 70. SASH WEIGHTS

FIGURE 72. BRASS PORT HOLE FRAGMENT (ARTIFACT 131-024)

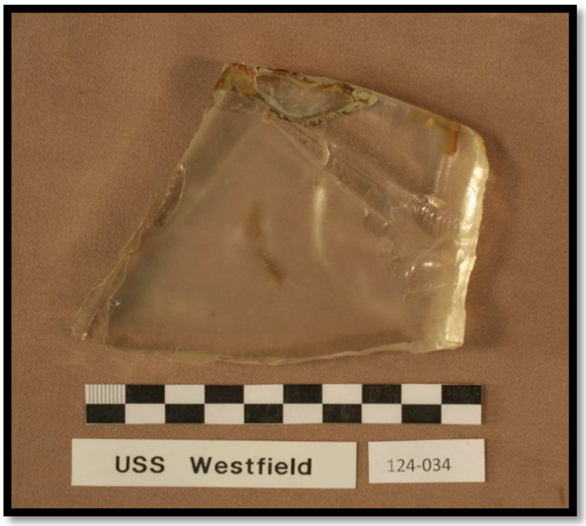

FIGURE 71. GLASS FRAGMENT FROM PORT HOLE (ARTIFACT 124-034; SCALE MM/CM)

FIGURE 73. THEORETICAL RECONSTRUCTION OF PORT HOLE

remained hidden in the wall compartments. In modern day, home renovators often find sash weights lying between wall studs of old homes even if a window frame is no longer present. This happens because someone removing a window simply cut the rope and let the sash weight fall down into the wall.

Replacement of windows with portholes was a necessity due to the walls having been covered to a height of 5 ft by boilerplate armor. Portholes allowed daylight to enter the cabin and provided more protection than large windows to the officers housed in the main deck cabin. Two porthole fragments were recovered from the site (Artifacts 124-034 and 131-024). Artifact 124-034 is a small glass fragment (Figure 71). There are four distinct diagnostic features that this artifact offers. The thickness of the glass, 5/8 inches, is common for porthole glass from the period. Other examples have been conserved from numerous shipwrecks, as has been described by the CRL's Head Conservator Helen Dewolf (personal communication 2014). One edge of the glass is curved, evidence of the object's original round shape, with an outer diameter of approximately 40 inches. Curved striations on its surface might have been caused by the frame that held the glass in place. These striations suggest that the interior viewing area of the window had a diameter of approximately 34 inches.The rounded rim of the glass appears to have been purposefully shaped by uniform chipping, as though someone intentionally knapped the glass to achieve the desired rounded shape. This suggests that part of the original glass did not conform to the outer frame and required post-production modification.

Artifact 131-024 is also believed to have come from a porthole but having a smaller diameter than Artifact 124-034. The object consists of a bent brass rim fragment with recessed fastening holes and a series of parallel ribs on the inside circumference (Figure 72). The outer diameter is about 13 inches. The backside of the rim is hollowed out indicating that the artifact was part of a frame. The ribs lining the margin of the interior curve might have functioned to hold a gasket in place. This object resembles the outer supporting rim of a porthole frame that was mounted to a wall surface. The complete porthole likely included a second inner frame holding the glass that could be closed and tightened into the gasket to create a watertight seal (Figure 73).

Historical images of Staten Island Ferryboats built by Simonson shipyards contain small portholes on the lower hull beneath the guards (Figure 74). These portholes allowed light to reach the lower boiler room and the machinery compartment. Based on its smaller size, similar to engine room portholes in historical images, the porthole rim fragment (Artifact 131-024) may have come from the lower hull. The Memphis drawing (Figure 3) indicates that the sponsons were boarded over, thus portholes on the lower hull would not have been visible when *Westfield* became a gunboat. The portholes, if left in place, would have been obstructed by the new enclosing boards. The glass fragment (Artifact 124-034) appears to have come from a larger window. Since rounded skylights have not been seen in converted ferryboat images, it is probable that this glass came from a larger porthole added to the main cabin when the ship was converted to a gunboat.

FIGURE 74. PORT HOLES ON STATEN ISLAND FERRYBOAT *MIDDLETOWN*
(PHOTO COURTESY OF THE MUSEUM OF THE CITY OF NEW YORK)

FIGURE 75. BRASS ARTIFACTS FROM CUPBOARDS

FIGURE 76. BRASS CABIN HOOKS
(ARTIFACT 119-216 & 121-145; SCALE MM/CM)

Westfield's main cabin structure was divided by a central machinery compartment. The ship's ferryboat configuration included open-ended corridors through the cabin on either side of the machine compartment allowing horse-drawn wagons to pass from one end of the ship to the other. Passenger cabins, four in all, were located outboard of the wagon corridors both fore and aft of the paddlewheel boxes. The two passenger cabins on each side of the ship were linked fore and aft by narrow hallways passing inboard of the paddlewheel boxes. After the navy purchased *Westfield*, the wagon corridors were closed off with doors to create internal hallways and a fully enclosed cabin. New walls were added inside the four passenger cabins to divide them into smaller spaces. The narrow hallways connecting the passenger cabins were closed off and turned into storage closets. Based on the Nestell drawing of USS *Clifton* (Figure 43), these newly divided passenger spaces were utilized as officer quarters and other rooms, including a kitchen and dispensary, necessary for running a naval ship (Cotham 2006:128).

Numerous recovered artifacts can be associated with these refurbished cabins. Most of these artifacts appear to have come from a variety of cupboards that likely facilitated personal storage. These objects include small turning knobs (Artifacts 105-017 and 107-026), a latching hook (Artifact 108-093), and two types of cupboard turning buttons (Artifacts 120-284, 121-078.1, and 132-128). It is very unlikely that these cupboard objects were retained from *Westfield*'s time as a ferry (Figure 75). Any cupboard storage would have been located in the saloon deck, which was removed during *Westfield*'s conversion. Based on surviving photography of *Westfield*'s sister ships, the lower main passenger cabins only contained enough room for seating and did not have space for any type of cupboard storage. Two hooks were also recovered (Figure 76). One can be easily identified as a common coat hook fragment (Artifact 121-145), while the other is larger and contains a pinhole that pierces through the end of the object (Artifact 119-216). The exact use of the latter object and its pinhole is not clear, but the object appears to be from a fixture designed to hold personal effects.

Some cabin artifacts might have been either original hardware on the ferryboat or added (or reused) when *Westfield* was converted to a gunboat. It is difficult to determine which came from *Westfield*'s time as a ferry and which were brought on board during naval conversion. One such artifact (125-037) consists of an elegant brass object decorated on the front surface to resemble a cord of rope (Figure 77). The back of the object is smooth, and the center contains a rounded hole. Conservators believe this object is a decorative frame, through which a doorknob turned. Other brass door pieces (Figure 78) consist of a strike plate for a door lock (Artifact 108-026), and a strike plate for a door knob (Artifact 109-099). A brass handrail bracket (Artifact 104-058) may have been part of a railing that lined the horse corridors and was kept aboard after naval conversion (Figure 79). Again, these objects cannot be easily dated. Railings could easily have been added after naval conversion to give crewmembers something to hold onto when traveling the hallways in rough seas.

FIGURE 77. DECORATIVE DOORKNOB FRAME
(ARTIFACT 125-037)

FIGURE 78. BRASS DOOR ARTIFACTS
(108-026 & 109-099; SCALE MM/CM)

FIGURE 79. BRASS HANDRAIL BRACKET
(ARTIFACT 104-058; SCALE MM/CM)

FIGURE 80. CAST IRON ROLLING CHOCK
(ARTIFACT 125-068; SCALE INCHES)

FIGURE 81. LEAD HAWSER PIPE
(ARTIFACT 107-069)

A single cast iron rolling chock (Artifact 125-068) was found near the stern area (Figure 80). This artifact was originally secured to the vessel with three fastening bolts. Like ships today, this object would have been used to guide securing lines when *Westfield* tied alongside another vessel or docked near land. Since the armored plates would have interfered with lines coming onto or leaving the vessel, the rolling chock may have been mounted on the outer guard. On the lowest part of the bulwarks, the water way timber allowed for deck drainage through scupper holes, and ropes or chains that passed through hawser pipes. An example of such a hawser pipe was recovered. Artifact 107-069 is made of lead and therefore likely received rope, since chains would have been too harsh on such a soft metal (Figure 81). The pipe measures 14.5 to 15 inches along the center excluding the flanges, consistent with the original bulwark thickness through which the pipe passed. On each end, the metal has been hammered down to create a rim or flange. Along the flanges, small holes indicate that the pipe was secured to the bulwarks with nails.

Excavations recovered nine chain segments from *Westfield*. The segments vary in length and preservation, but all were determined to have come from the same size/type of chain (Figure 82). Five of the segments were found across three sequential grids (102, 103, and 104), starting in what archeologists believe was *Westfield*'s stern area, and moving east towards the former main cabin. The chain is too small for securing cannon tackle or to be used for hauling the anchors. Based on the recovered locations, these chains may have been used to steer *Westfield*'s stern rudder. The chains would have connected beneath the deck on both sides of the rudder, and then would have run under the main cabin, before being redirected on chain rollers, up into the rear pilot house. For comparison, similar sized rudder chains can be seen on the steamboat *Ticonderoga* (Figure 83).

Westfield's hull is known from Confederate salvage accounts to have been sheathed with copper below the waterline. The use of copper sheathing was a time-honored method to protect the wood hull from *teredo* consumption and also to reduce fouling. Copper does not form concretion (unless in contact with or in close proximity to iron) and would have been easy to identify, yet very little copper sheathing was recovered from the site. It is likely that Confederate salvers removed any sheathing accessible from the sides of *Westfield*'s hull. Substantial portions of sheathing should have remained, following their salvage efforts; however, by 1906, when additional materials were removed from the site, very little hull remained. Once wooden portions of the ship had deteriorated, storm currents might easily have carried the remaining sheathing away. Only two small fragments of sheathing were recovered (Artifact 132-1.6 and Artifact 133-114). Artifact 132-1.6 (Figure 84) was screened from sediment that was inside the firebox. Along the upper edge of the fragment are attachment holes for the sheathing tacks; these are spaced between 1.5 and 1.8 inches apart and are inset about 0.5 inches.

The largest single category for the artifact assemblage is fasteners. Over 1,800 fasteners have been documented and include 1,565 nails, 143 spikes, 94 bolts, and 18 screws. Though there are many

FIGURE 82. WROUGHT IRON CHAIN
(ARTIFACT 102-004; SCALE CM)

FIGURE 83. RUDDER CHAINS ON
STEAMBOAT *TICONDEROGA*

FIGURE 84. COPPER HULL SHEATHING
(ARTIFACT 132-001.06)

FIGURE 85. COPPER SHEATHING TACKS
(ARTIFACT 108-071)

FIGURE 86. BRASS SPIKES
(ARTIFACT 121-154; SCALE CM)

FIGURE 87. BRASS THROUGH BOLT
(ARTIFACT 118-159; SCALE CM)

different fastener types, certain examples were purpose-made for more-specialized uses. This pertains primarily to small cupreous tacks for attaching sheathing to the hull; the cupreous spikes that were used to nail planks to the frames and deck planks to the deck beams; and the cupreous bolts that were used along the keel and sister keelsons. These fasteners were manufactured from copper/tin alloys like brass or bronze because they were used in a salty, marine environment and in many cases came in direct contact with water. Fasteners used below the waterline and that were in contact with copper sheathing could only be manufactured of a similar alloy metal, as the interaction between iron fasteners and copper sheathing would degrade the iron through galvanic corrosion. Sheathing tacks are essentially small cupreous nails with a large diameter round head (Figure 85). The sheathing tacks from *Westfield* are typically about 1.1 to 1.5 inches long with heads of about 1/3-inch diameter, though larger and smaller head diameters are common. The cupreous spikes had three primary uses, as “single deck nails,” “double deck nails,” and “boat nails.” Single deck and double deck nails fastened the deck planks to the deck beams, and boat nails attached planks to frames. Boat nails were of varying lengths, were square at the point and generally rose-headed (McCarthy 2005:175). The deck nails from the *Westfield* site are typically 6.0 to 7.0 inches long with a 0.65- to 0.75-inch square head (Figure 86). There are several cupreous through-bolts that are likely from the keel or keelson of *Westfield* (Figure 87). The larger bolts range from 10 to 19 inches in length (some are broken) and have a shaft diameter of approximately 0.75 inches. Some examples, like Artifacts 107-035, 108-006, and 120-077, are through-bolts that still retain their clinch ring. The clinch ring is a round washer that was placed at either or both ends of a bolt. The act of hammering the bolt (clinching) caused the bolt head to flatten against the clinch ring and helped secure it in place. The clinch rings have a diameter of approximately 1.25 inches (McCarthy 2005:181).

Iron bolts and spikes made up most of the recovered concretions. For nearly every type of cupreous fastener identified from the wreck site, there is an iron counterpart, notable exceptions being copper hull tacks and a brass dove-tailed keel fastener. Other iron fastener types not represented by cupreous counterparts include fasteners to support large beams, flat headed deck bolts, and pad eyes. Iron fasteners often were very poorly preserved and required molding and casting to preserve their details. Fortunately enough examples survived to determine that the range of sizes represented are almost identical to the cupreous fasteners. Cupreous fasteners were preserved much better. While many were weathered, others clearly retained strike marks from when they were driven into *Westfield*'s hull.

A few of these artifacts (118-022, 119-233, 134-037, and NP-13.2) display saw and hack marks that indicate the objects were removed intentionally by force (Figure 88). One of the most obvious artifacts to display these marks (Artifact 138-051.1) appears to be fastener related, but also contains decorative circles molded into the metal. This artifact was sawn off at an angle, leaving distinct teeth marks in the metal before the saw broke through and ripped off part of the edge (Figure 89).

FIGURE 88. ARTIFACTS WITH HACK AND SAW MARKS (ARTIFACT 118-022, 119-233, 134-037, & NP-13.2; SCALE MM/CM)

FIGURE 89. SAWN ROUNDED ARTIFACT (ARTIFACT 138-051.1; SCALE MM/CM)

FIGURE 90. LARGE WOOD FRAGMENT WITH IRON FIXTURE (ARTIFACT 108-130; SCALE INCHES)

FIGURE 91. BOLT AND WOOD FRAGMENT ERODED FROM CURRENTS (ARTIFACT 123-055; SCALE CM)

Westfield's hull did not survive; however, numerous timber fragments were recovered from the site. Most of these wood fragments survived because of the iron fasteners that once passed through them. As the iron corroded, the wood became impregnated with ferrous material, which prevented the wood's cell structure from collapsing. After conservators removed concretion from the wood, the bolt holes often remained intact, preserving the diameter of the no longer existent fastener. These wood fragments do not reveal much information about *Westfield*'s hull construction other than fastener dimensions; however, two such artifacts are worth mentioning.

The largest surviving wood fragment (Artifact 108-130) measures approximately 16 inches long x 8 inches thick (including the bracket) x 7.5 inches wide. This artifact survived because of a large cast iron fixture that is attached to the wood's top surface. The fixture has heavy raised projections or ridges presumably designed to support another structure. An illegible three-digit number (possibly 082, 532 or 522) is embossed on the surface of one projection. Four bolts that did not survive once attached the object to the wood. On the underside of the fixture, an additional ridge was received by a channel cut into the wood. This mortise and tenon-like feature would have helped prevent the fixture from sliding and placing too much lateral strain on the bolts. Although the purpose of this fixture is not known, the object was reinforced to support a heavy load (Figure 90).

A second artifact (123-055) consists of a wood fragment and a brass bolt (Figure 91). Both the bolt and the wood have been scoured by currents and over time, worn down and polished. While the artifact does not offer much information regarding hull construction, the deep erosion marks on the wood's surface reflect the high energy currents that passed over the wreck site, contributing to the disintegration of *Westfield*'s hull.

Steam Machinery

Most of the largest recognizable iron and brass artifacts recovered from *Westfield* were associated with the machinery, including especially the steam engine and the boilers. Considerable research into the function of these many machine components was conducted by the *Westfield* conservation project manager, Justin Parkoff, as conservation progressed. The discussion of engine and boiler artifacts is prefaced by a summary of walking beam engines and return flue boilers. The authors do not presuppose that readers possess detailed knowledge of these subjects so felt it important to provide context for the subsequent discussion of the artifacts. Discussion of important artifacts is woven into that of the engine and boilers in general and of the reconstruction of *Westfield*'s machinery in particular (Figure 92).

The Walking Beam Engine

American walking beam engines were based on the 18th-century Newcomen engine, a considerably smaller device which was utilized to extract water from English coal mines (Whittier 1983:5). In the

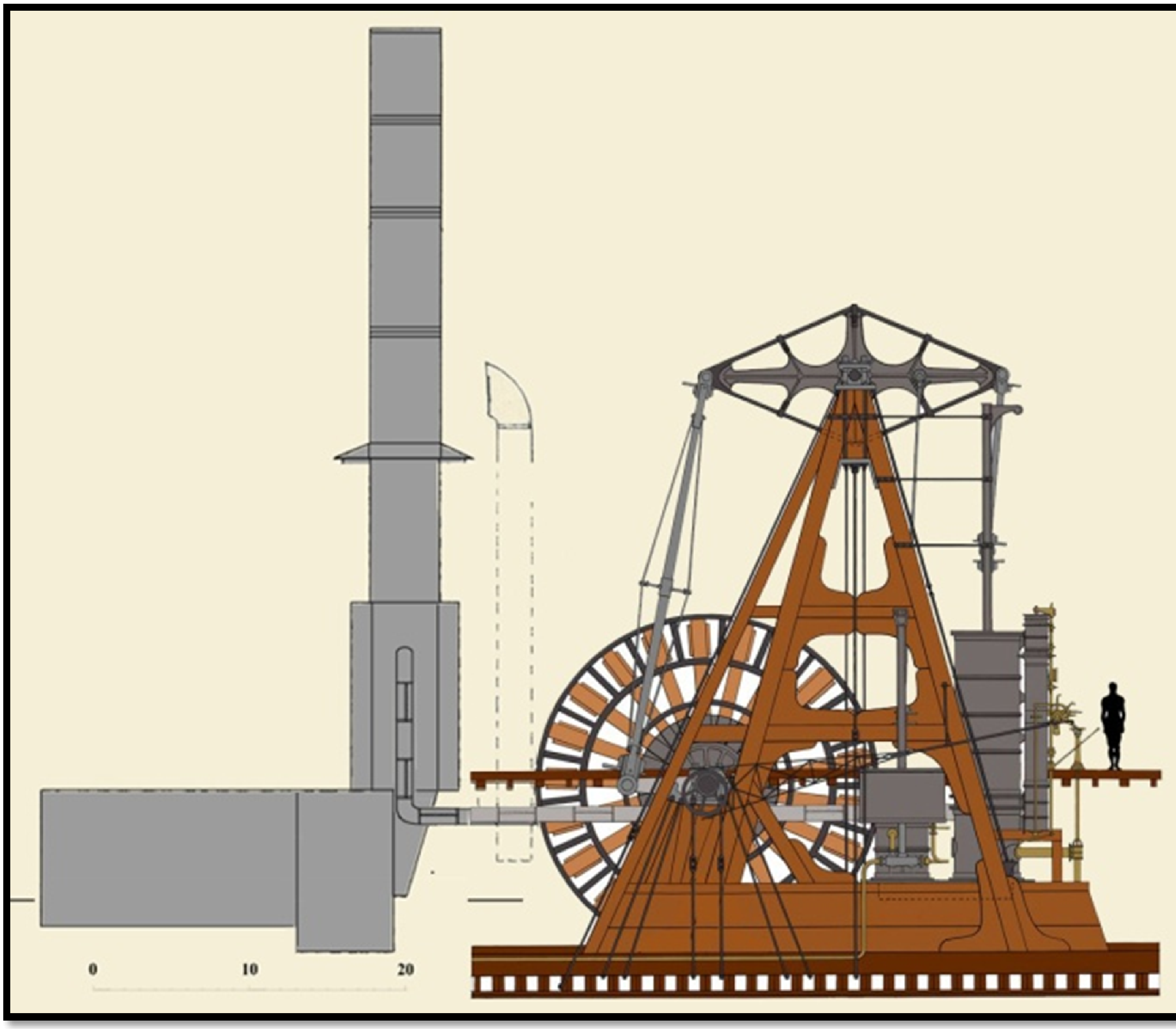

FIGURE 92. RECONSTRUCTED SIDE VIEW OF *WESTFIELD*'S MACHINERY

early 19th century, variations of this low pressure engine began to appear on American side-wheel steam vessels. By the 1850s, the walking beam engine surpassed the more common side-lever engine, and became the most widely used marine engine in America. Compared to other marine engines at the time, the popularity of the walking beam engine is attributed to the engines' simplistic and inexpensive design (Sheret 2005:52). These engines proved easier to maintain and repair over long periods of time. A well-maintained engine on average lasted 30-40 years, a service life that often surpassed the vessel on which the engine was placed. Some engines even lasted 50-60 years. After a vessel was retired, the walking beam engine was often removed, reconditioned, and continued in service on one or more other vessels (Whittier 1983:13).

In general design, a walking beam engine operated by utilizing a massive steam cylinder with an internal piston. The piston connected to the end of a diamond shaped beam lever that was supported by a large wooden "A" shaped frame. The beam pivoted or "walked" back and forth at the peak of the A-frame when the piston moved up and down. On the other side of the walking beam, a connecting rod pushed down on a crank arm attached to the paddlewheel shaft. This downward cranking motion acted similarly to a bicycle pedal by turning the vessel's paddlewheels.

Engine Components

The main components of a walking beam engine are the A-frame, steam chest, cylinder, piston, condenser, air pump, hot well, walking beam, connecting rod, crankshaft, and eccentric arm, shown in Figure 93. The unique shape of the A-frame, also known as the "gallows frame," helped to evenly distribute the weight of the walking beam and the paddlewheel shaft. This frame was built of enormous wooden beams heavily braced by knees. Underneath the A-frame, an even more massive wooden bed frame supported the weight of the entire engine over a long portion of the vessel's hull.

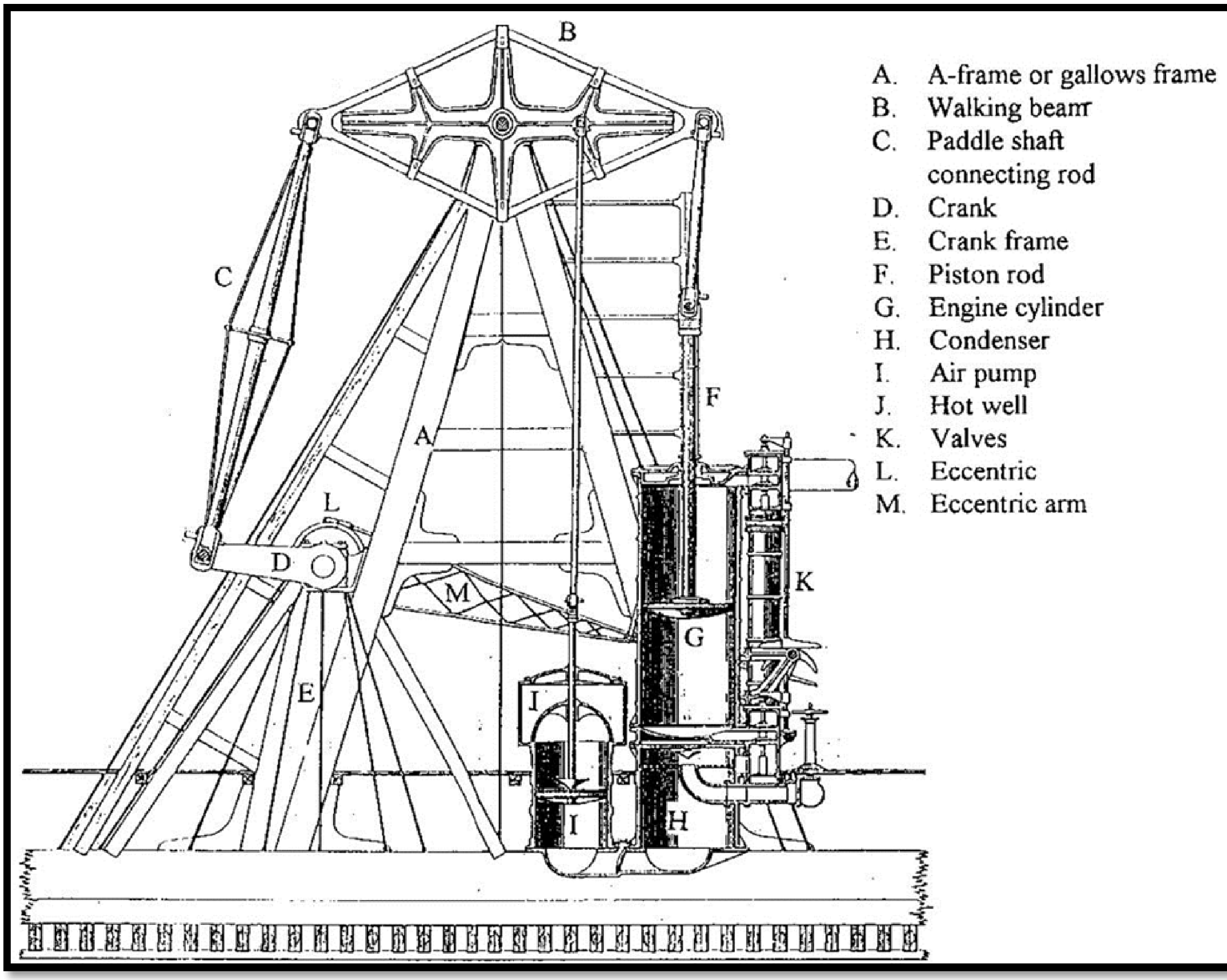

FIGURE 93. COMPONENTS OF A WALKING BEAM ENGINE
(INTERNATIONAL CORRESPONDENCE SCHOOLS 1897:64-65, FIG. 329)

To counteract the lifting forces created by the cylinder's piston, the A-frame incorporated numerous iron rods that further braced the structure to the bed frame. These rods could be tightened through the use of turnbuckles. As part of regular maintenance, the engineer monitored the tension of these rods to ensure that the engine remained stabilized over long periods of use (Whittier 1983:13).

From the vessel's boilers, heated steam passed through a long steam pipe, which traveled to the steam chest located in the main engineering room. The steam chest consisted of two main chambers. One chamber acted as an intermediate storage area, the intake manifold, where steam gathered before entering the engine cylinder. The second chamber, the exhaust manifold, acted as an area for exhausted steam to gather after leaving the engine cylinder (International Correspondence Schools 1897:66).

The engine cylinder was double-acting, meaning steam was utilized alternately from both above and below the piston (Sheret 2005:16). This design facilitated the piston's movement up and down. Steam was transferred to either end of the cylinder in time with the piston’s position by the coordinated action of four lifting rods each connected to dual poppet valve assemblies within the steam intake and exhaust manifolds (Figure 94). When the engine was in motion, two of the combined rod and poppet valve assemblies worked in tandem, yet alternately with the other two assemblies. When the first valve assembly lifted, releasing steam into the top of the engine cylinder, the second valve assembly simultaneously opened to exhaust used steam from below the piston. Upon completion of the transfer, the third and fourth rods performed the same task, except in reversed position. The second transfer released steam into the bottom of the cylinder and exhausted used steam out from the top of the cylinder.

Steam passed through the exhaust chamber after leaving the cylinder and collected in the condenser beneath the main cylinder. The condenser and air pump worked in concert to cycle hot water, recaptured from steam, back to the boilers. Cold sea water was injected into the condenser through a gravity fed pipe. Water sprayed up into a cone-shaped projection placed above the pipe, cascading evenly over the entire chamber and condensing the hot steam back into water. Condensation created a natural vacuum that aided the piston's movement (International Correspondence Schools 1897:65).

The air pump cylinder (Figure 93) in *Westfield* would have been immediately forward of the main cylinder and condenser assembly. A piston within the air pump was powered by the motion of the walking beam. When the air pump piston moved up, the suction pulled a mixture of air and water out of the condenser (Whittier 1983:13). This mixture passed into the "channel way" underneath both cylinder assemblies, and then up towards the hot well, which sat on top of the air pump (Edwards 1883: xxxi, fig. 1). The end of the piston stroke lifted a domed cover above the air pump allowing water (condensed from steam) to fill the upper hot well. Excess water was diverted overboard through a spillway pipe. When the piston reversed motion and moved down, the lid quickly sealed. The trapped pressure pushed water from the hot well into a separate valve

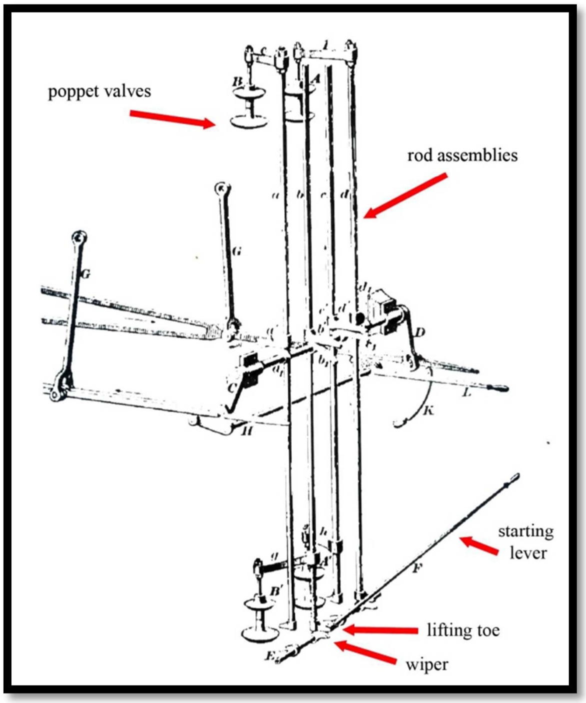

FIGURE 94. LIFTING ROD AND POPPET VALVE ASSEMBLIES. THE STEAM CHEST HAS BEEN OMITTED TO VIEW THE ASSEMBLIES; MODIFIED FROM INTERNATIONAL CORRESPONDENCE SCHOOLS (1897:69, FIG. 331)

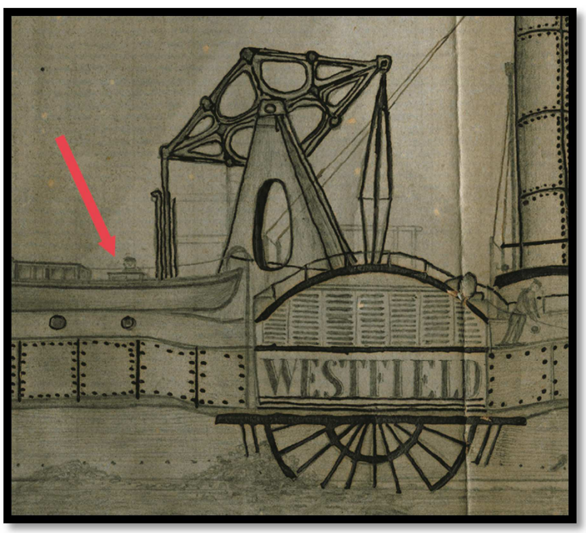

FIGURE 95. SMALL DECK STRUCTURE (ARROW) BETWEEN PILOT HOUSE AND CROSSHEAD CHANNELS; MODIFIED FROM 1862 SKETCH OF WESTFIELD

FIGURE 96. LARGE CYLINDER FRAGMENT (ARTIFACT 134-007; SCALE INCHES)

FIGURE 97. FRAGMENT FROM TOP OF CONDENSER (ARTIFACT 132-016; SCALE DM)

FIGURE 98. FRAGMENT OF CYLINDER ON BASEPLATE (ARTIFACT 138-001)

assembly that ultimately fed back to the boilers. As the piston continued to move down, the increasing pressure closed the one-way air pump foot valve, located in the lower channel way (International Correspondence Schools 1897:65). This prevented water from flowing back into the condenser from the air pump.

The massive walking beam consisted of a diamond-shaped wrought iron band mounted around a central cast iron skeleton. Two large trunnions at the center of the skeleton on each side served as the walking beam's main cantilever (International Correspondence Schools 1897:64). The main walking beam trunnions were supported by twin cast iron bearing blocks with brass bushings that formed the pinnacle of the A-frame.

The piston rod exposed above the cylinder connected by way of a crosshead with two shorter rods known as "connecting links". The upper end of the connecting links attached to trunnions at one end of the walking beam. The crosshead allowed the connecting rods to pivot slightly fore and aft as the end of the walking beam moved through an arc thus allowing the piston rod to remain vertical. The crosshead was guided by iron channels that ran vertically above each side of the cylinder to ensure the piston rod could not deviate. These channels were secured to the A-frame with iron struts for extra stability (International Correspondence Schools 1897:64).

The opposite end of the walking beam contained trunnions that formed the mounting point for the main crank arm's connecting rod. This rod transferred the walking beam motion to the rotary crank arm on the paddlewheel shaft. To ensure that this massive rod did not bend, supplementary rods were bolted at the ends, and bore against braces fixed at the connecting rod's center point (Whittier 1983:13, 15). Bearing blocks supported the enormous weight of the paddlewheel shafts at their juncture with the crank arm (Whittier 1983:15).

Engine Proportions

Like most marine engines in the 19th century, each walking beam engine was designed and customized by the builder to accommodate a specific vessel (Sheret 2005:16). No single plan existed for the engine type. Despite this, all walking beam engines followed the same principles and were similar in construction. Proportion played a significant role in designing engines for new vessels or reusing older components from previous vessels. The main issue of proportion focused on the size and stroke of a vessel's engine cylinder. The distance the piston travelled from the top to the bottom of the cylinder was known as the "stroke". This distance was proportioned to other key areas on the engine. The length of the crank arm, or the "throw of the crank," measured exactly half of the piston stroke (Whittier 1983:15). When the walking beam lay perfectly horizontal, the piston remained at a half stroke within the cylinder. This caused the crank arm to also remain horizontal. Therefore at the beginning of a stroke, the crank arm pointed strait down, and at the end of a stroke, the crank arm pointed strait up (International Correspondence Schools 1897:70).

The size of other engine components varied considerably without an apparent pattern. A-frame and walking beam size could be adjusted within limits as long as the proportions of the engine stroke were followed. Building an A-frame too short would have caused the walking beam to interfere with the stroke of the cylinder and building an A-frame too tall would have overstressed the connecting rods that facilitated the walking beam's movement. Fortunately, in the case of *Westfield*, numerous artifact fragments provide clues that, in conjunction with the historical record, allow many engine components to be reconstructed. Dimensions of other engine parts not represented in the artifact assemblage can be determined by examining the proportions of equivalent components found on other walking beam engines and fitting those theorized elements within the known parameters of *Westfield*'s hull.

Historical Data

Three types of historical sources assisted with a virtual reconstruction of *Westfield*'s engine. The first sources were measurements found in legal documents and period publications. For example, enrollment and licensing documents state that *Westfield*'s lower hull measured 213 ft 4 inches x 34 ft x 12 ft 11 inches at 891 tons (see copies in Appendix A-1). Later secondary accounts state that Morgan Iron Works constructed the engine with a 50 inches diameter cylinder that contained a 10 ft piston stroke (Heyl 1965:335). Finally, the paddlewheels were 22 ft in diameter by 9 ft wide (Main 1893:133).

The second source was a scale drawing of *Westfield* completed two weeks before the ship was destroyed. Although no known photography or plans of *Westfield* have been recovered, a supposed eyewitness sketch of the vessel provided an important source of historical information. Historian Ed Cotham informed Atkins of a *Westfield* sketch he had discovered in the Memphis Public Library. Atkins subsequently purchased a high-resolution digital copy of the drawing from the Memphis Public Library (Figure 3). The drawing is dated December 16, 1862. The artist included a detailed scale that runs the length of the vessel. While any illustration or iconography should be reviewed with caution due to stylization issues brought on by an artist's interpretation, the size of certain features on the sketch have been confirmed by artifacts recovered from the wreck site. In particular, the dimensions of boilerplate armor shown on the drawing is consistent with the 5- x 5-ft size of a complete plate recovered from the site. Other drawing details are consistent with historic details of *Westfield*’s conversion to a military gunboat, including removal of the upper saloon deck, lowering of the wheelhouses, and the use of hinged iron plates to protect the gun decks. In general, the Memphis drawing of *Westfield* appears to have been drawn with great care and appears to be quite accurate in its details and dimensions.

The third, and perhaps most useful source of historical information, was a proposal written by the naval architect William Cowles in 1886. The proposal emphasized the need to modernize the fleet of Staten Island ferryboats. He explained that the ferryboat design had "remained practically the same as they were thirty years ago" (Cowles 1886:191). While the points of the proposal are not relevant to this discussion, Cowles included a useful architectural drawing of the Staten Island ferryboat *Southfield II* (Figure 42). Cowles' drawing, when viewed in light of construction details gleaned from various other sources, suggests that the plan of both *Westfield* and *Southfield II* were very similar. By modifying Cowles' drawing to incorporate *Westfield*'s enrollment figures, the vessel's maximum measurements above the main hull can be determined. *Westfield* measured approximately 225 ft length over all, 63 ft beam over guards, 17 ft depth molded (from underside of main deck to bottom of keel), and with an estimated draft loaded of 8 to 8.5 ft.

Paddlewheel Shaft, Engine Cylinder, and Condenser

Placement and scale of some of *Westfield*'s key machine components are depicted in the Memphis drawing (Figure 3). Confidence in those placements is reinforced by agreement with *Southfield II* plans. *Westfield*'s paddlewheel is small in relation to the size of its walking beam and its hull in general. The paddlewheel shaft on the Memphis drawing is situated just below the level of the main deck and closer to the water than typical in order to accommodate the smaller paddlewheel. *Southfield II* plans, likewise, show a relatively small paddlewheel and a lower placement of the paddlewheel shaft, suggesting that these characteristics might have been typical of Staten Island ferryboats from this period

Westfield's cylinder and steam chest appear to have been placed at the same height and location as on *Southfield II*, as evidenced by a small box-like structure illustrated on *Westfield*'s hurricane deck (Figure 95). After the U.S. Navy purchased *Westfield*, the vessel underwent a refit that reduced the superstructure to 8 ft above the main deck. Assuming the engine size and placement on *Westfield* matched that shown on the *Southfield II* plans, the upper 1 ft of *Westfield's* engine cylinder and steam chest would have extended above the upper deck after the deck was lowered for military use. Due to the delicate nature of the steam chest's rod and poppet valve assemblies, a protective cover would have been necessary. The box on the Memphis drawing appears to have provided that protection. The *Southfield II* plans (Figure 42) show the base for the cylinder and steam chest 2 ft below the level of the main deck and reaching a height of 11 ft. Like *Southfield II, Westfield*'s engine had a stroke of 10 ft. The total height of both engines is presumed to match closely. The extra 1 ft of cylinder height on the *Southfield II* drawing is accounted for by the cylinder's top cover and by the lower piston bed that stopped the piston after a stroke was completed.

Westfield's lower condenser can be theoretically reconstructed, based on *Southfield II* plans, to a height of 5 ft. Usually condensers measured approximately one third or more of the main cylinder height. Too small of a condenser might allow water to overflow back into the main cylinder (Sheret 2005:138). The combined height of *Westfield*'s cylinder and condenser assembly would have been about 16 ft including 10 ft of cylinder stroke plus 1 for the cover and piston bed, plus 5 ft for the condenser. Accounting for *Southfield II*'s 1 ft thick main deck, *Westfield*'s known 12 ft 11 inches depth of hold, and the already discussed placement of the cylinder and condenser assembly, a space of 6 ft 11 inches remained beneath the engine assembly for hull frames and the large bed timbers that supported the walking beam engine.

Several fragments of *Westfield*'s cylinder and condenser assembly have been identified, of which four are of considerable size (Figure 96). All of these fragments have a curvature consistent with a diameter of 50 inches, matching the historical record. Most engine cylinders had a wall thickness of 1 to 1.5 inches but also incorporated stiffening rings spaced evenly along the cylinder assembly as a method of reinforcement (Whittier 1983:15). *Westfield*'s cylinder and condenser artifacts are 1 inch thick and many exhibit stiffening rings measuring 5 inches high and 0.5 inches thick (in addition to the wall thickness). All four of the larger curved fragments can be identified as coming from the lower condenser. Although heavily weathered, Artifact 132-016 still contains a broken remnant of the dividing plate that separated the condenser from the upper cylinder (Figure 97). Two of the artifacts (132-006 and 138-001), are still bolted to the base plate that formed the condenser's foundation (figures 98 and 99). In order to secure the engine cylinder and condenser together to the lower base plate, the ends of each cylindrical component contain a 1-inch-thick lip, 4 inches wide. On this lip, fastening bolts are spaced 6.5 inches apart. In total, four base plate fragments were recovered (132-001.91, 132-006, 138-001, and 140-004). These plates are 1.75 inches thick. During initial de-concretion efforts, conservators noticed that all of these plates retained wooden splinters on their undersides from the massive bed frame timbers that formed the foundation of the entire engine. Amazingly, Artifacts 132-006 and 138-001, along with Artifact 134-007 (no base plate) still fit together and can be rejoined along their fracture points (Figure 100). Based on the rejoining of these artifacts and the known orientation of *Westfield*'s engine (condenser/engine cylinder aft, air pump/hot well forward), conservators were able to determine that these three artifact came from the starboard side of the vessel. Following the bolt pattern on these joined artifacts, base plate Artifact 132-001.91, which could not be rejoined, came from *Westfield*'s port side (Figure 101).

Beneath the base plate fragments, portions of the "channel way" leading to the air pump survived. The largest channel fragment, found on Artifact 138-001 (Figure 102), although incomplete, indicates that the port and starboard sides of the channel way were relatively flat and the chamber had a depth of at least 1 ft. Numerous fragments from the channel way walls survived independently. These fragments, combined with the portions that remained attached to the base plates, allowed conservators to determine that the original shape of the channel way was designed to facilitate the forward movement of water. One smaller fragment came from the aft portion of the channel way (Artifact 133-004). This fragment shows that the shape of the condenser continued down into the channel way creating a rounded aft wall (Figure 103). The largest recovered base plate fragment (Artifact 140-004) supported the air pump/hot well cylinder assembly. A surviving section of the inner ring on the base plate has a diameter of 42 inches. Remnants of the channel way show that its walls slightly narrow in the forward direction to accommodate the smaller diameter of the air pump cylinder (Figure 104). Artifact 140-004 is from the starboard side of the channel way.

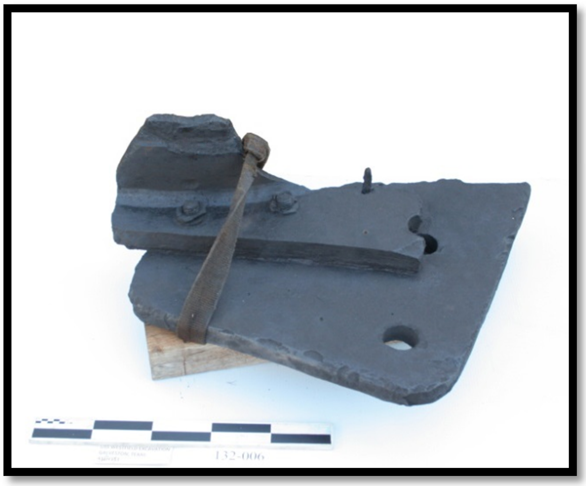

Figure 99. Fragment of cylinder on baseplate (artifact 132-006; scale cm/dm)

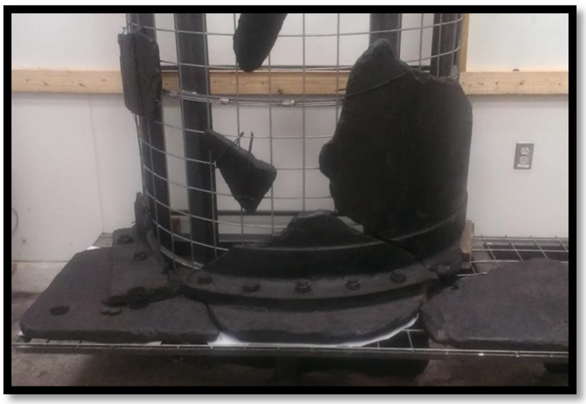

Figure 100. Rejoined cylinder fragments (artifacts 132-006, 138,001, & 134-007)

Figure 101. Fragment of baseplate (artifact 132-001.91; scale dm)

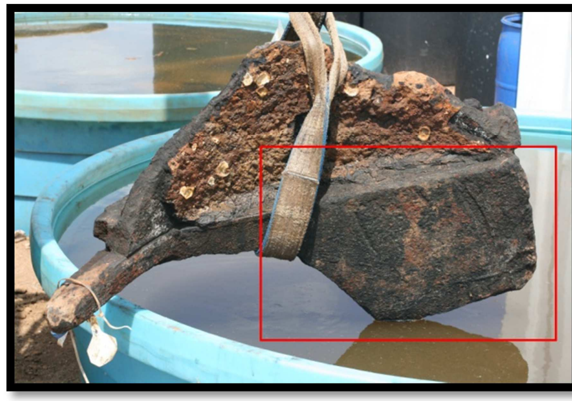

Figure 102. Lower fragment of channel way (artifact 138-001)

Figure 103. Rounded fragment from rear channel way wall (artifact 133-004)

Figure 104. Underside of air pump base plate with narrowing channel way wall (artifact 140-004; scale cm)

Air Pump and Hot Well Assembly

No historical information has been found regarding the construction of *Westfield*'s air pump and hot well. Fortunately, in addition to the lower base plate fragment (Artifact 140-004), a large artifact from the air pump was recovered remarkably intact (Artifact 132-017). This artifact is one of two valve assemblies that received water from the upper hot well reservoir as a means to refuel the boilers' water level (Figure 105). Like the base plate fragment, the recovered valve assembly came from the starboard side of the engine assembly. This placement is evident due to the forward flowing direction of the interior valves. The artifact measures 2 ft long, 10 inches wide, and 6 inches tall. The pipe that led to the forward boilers has a diameter of 4 inches and an attachment flange with a diameter of 9 inches. The feed pipe that led down from the hot well reservoir is broken but can be reconstructed with a diameter of 7.75 inches. After removing protective cover plates and broken pipe flanges, conservators recovered all of the original sealing gaskets (Figure 106). Inside the artifact, two brass valves are held in place by brass wedges, all of which are seated in lead (Figure 107).

Originally, this artifact was mounted outside the air pump cylinder on a shelf, directly beneath the hot well reservoir (Figure 108). Both the shelf and a large fragment of the air pump cylinder survived with the valve assembly. The shelf measured 1 ft 4 inches wide and 6 inches tall from the base plate. The air pump cylinder fragment indicates an internal diameter of 40 inches that fit into the curved portion of the base plate (Artifact 140-004), and like the condenser/engine cylinder, was mounted with a reinforced supporting flange that bolted down over the plate. Unfortunately, the exact heights of the air pump and the hot well can only be speculated. On most walking beam engines, this dual assembly generally reached just slightly taller than both the condenser and the engine cylinder's lower piston stop. Applying this generality to *Westfield*, the height would have measured approximately 6 feet tall. Based on other walking beam engines, the air pump cylinder, if completed, once contained a rounded flange at the top with a rim that stood just inside the edge. This flange was utilized as a lower base plate for the hot well reservoir cover. During construction, the cover would have been lowered down and seated onto this plate. The rim on the plate sat inside the cover, preventing the cover from sliding off. One fragment from this plate and rim survived (Artifact 132-001.57). The rim on this fragment sits 1.5 inches inward from the ledge, indicating that the cover contained a general thickness of 1 inch, plus a 0.5 inch stiffening ring at the bottom. Based on the curvature, the rim on the plate had an inside diameter of 5 ft 2 inches. Adding the thickness of the missing cover (not accounting for the stiffening rim), the hot well reservoir had an inside diameter of 5 ft 4 inches.

The combined base plate for both cylinders was attached to the lower bed frame timbers with massive wrought iron bolts. Several of these bolts were recovered. The top of the bolts are threaded, upon which a square nut is secured (Artifacts 117-001 and 138-003). The bolts passed

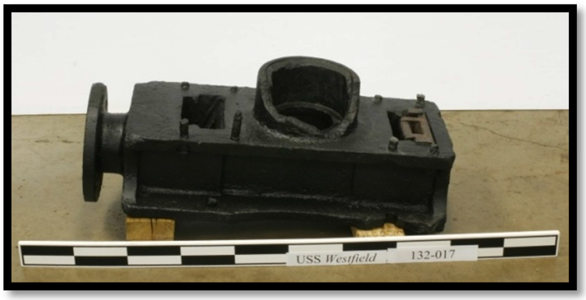

FIGURE 105. VALVE ASSEMBLY FROM AIR PUMP/HOT WELL RESERVOIR (ARTIFACT 132-017; SCALE DM)

FIGURE 106. EXAMPLES OF INTACT GASKETS FROM VALVE ASSEMBLY (ARTIFACT 132-017.6 AND 132-017.8)

FIGURE 107. BRASS VALVE AND WEDGE FROM VALVE ASSEMBLY (ARTIFACTS 132-017.12 AND 132-017.13)

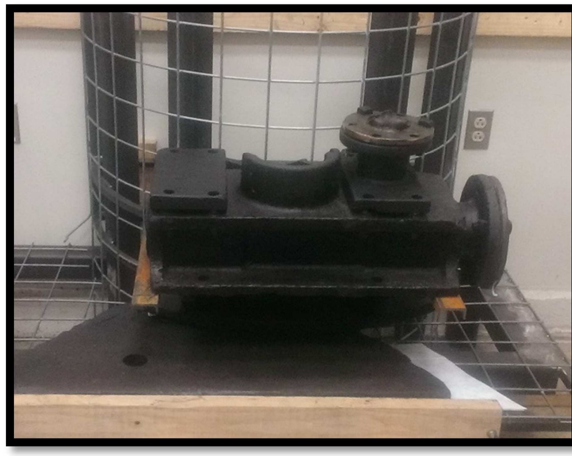

FIGURE 108. RECONSTRUCTED VALVE ASSEMBLY AND LOWER BASE PLATE FRAGMENT (ARTIFACTS 132-017 AND 140-004)

FIGURE 109. TYPE 1 MASSIVE BOLT AND WASHER FASTENER FOR CYLINDER BASE/BED FRAME TIMBERS (ARTIFACT 138-003; SCALE CM/DM)

FIGURE 110. TYPE 2 MASSIVE BOLT FASTENER FOR CYLINDER BASE/BED FRAME TIMBERS (ARTIFACT 132-001.92; SCALE DM)

through rounded holes in the base plate as seen in figures 99 and 104. Each hole had a diameter of 2 to 2.25 inches. Cast iron washers lay between the square nut and the plate surface (Figure 109). The washers acted as a sacrificial surface that could rotate if needed and spread the load placed on the bolt heads (Jim Jobling, personal communication 2014). A variant of this bolt type was also recovered (Artifact 132-001.92). Rather than containing a smaller square nut and an underlying washer, this bolt instead utilized a single larger wrought iron nut that accomplished both tasks (Figure 110).

Reconstructing the A-frame

Like the cylinder and condenser assembly, *Westfield*'s A-frame can be reconstructed through a piecemeal process. The Memphis drawing portrayed approximately 18 ft of *Westfield*'s A-frame rising above the main cabin. The lower portion can be determined by accounting for the combined 12 ft 11 inches depth of the hold, the 1 ft thick main deck, and the 8 ft high main cabin. Approximately 21 ft 11 inches of the A-frame lay hidden from view. Adding the hidden 21 ft 11 inches section and the 18 ft visible section, *Westfield*'s A-frame reached 39 ft 11 inches or approximately 40 ft tall. The projected height of the A-frame makes sense when compared to the *Southfield II* plans, since *Westfield* had a substantially taller superstructure before the U.S. Navy converted the vessel into a gunboat.

On the Memphis drawing (Figure 3), the artist incorporated a curious oval shape underneath the walking beam. There has been much controversy by *Westfield*'s researchers as to what this oval may represent. As a means to settle this discussion, an image of the ferryboat *Eureka* displays what appears to be a similar shape (Figure 111). Close examination of the *Eureka* image reveals that the oval is an optical illusion caused by shadows cast from the bearing block onto reinforcement knees. This realization assisted the reconstruction by allowing two larger wooden knees to be added to the upper portion of *Westfield*'s A-frame. Regarding the hidden portions of the frame, the placement of similar knees and supports must be conjecturally based upon other walking beam engines.

During *Westfield*'s excavation, archeologists recovered one of the large bearing blocks (Artifact 133-002) that supported the walking beam (Figure 112). This artifact provided significant information that assisted in reconstructing *Westfield*'s A-frame. The bearing block was made up of two large cast iron components that were connected by long wrought iron rods. Although compressed during the wrecking process to a height of 6 ft, a protruding connecting rod suggested that the original bearing block measured over 7 ft 6 inches tall. This measurement does not account for the missing cap square.

In original placement, the bearing block stood erect at 90 degrees to the keel. The artifact's purpose also served to clamp the A-frame's beams together at the pinnacle. Since the beams rested between the bearing block's two parts, the components were molded to support the angle of the beams. On

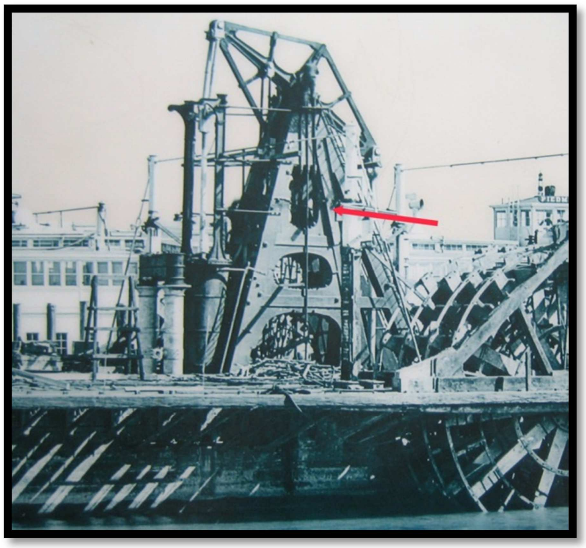

FIGURE 111. WALKING BEAM OF FERRYBOAT *EUREKA* - LARGE KNEES CREATED OVAL SHAPES IN THE A-FRAME (IMAGE COURTESY OF THE SAN FRANCISCO MARITIME NATIONAL HISTORICAL PARK)

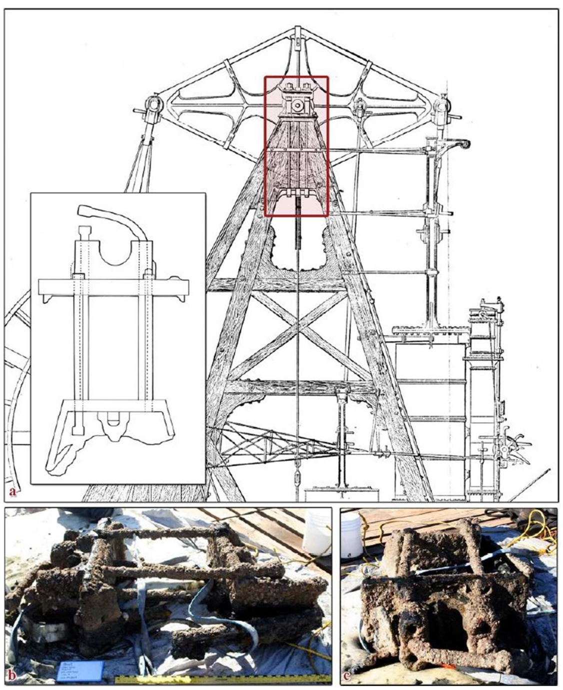

FIGURE 112. BEARING BLOCK FROM *WESTFIELD* WALKING BEAM (ARTIFACT 133-002; SCALE INCHES)

FIGURE 113. SMALLER TURNBUCKLE FROM SMOKE STACK (ARTIFACT 133-034; SCALE CM/DM)

FIGURE 114. LARGE TURN BUCKLE FROM A-FRAME (ARTIFACT 117-002; SCALE CM/DM)

FIGURE 115. ROD ARTIFACT WITH THREADED BRASS BUSHING (ARTIFACT 133-053)

FIGURE 116. WALKING BEAM FROM USS *CLIFTON* AT RIVERFRONT PARK, BEAUMONT, TEXAS (UNKNOWN PHOTOGRAPHER)

the lower component, the sides flared out to 195 and 165 degrees, indicating the angle of the primary wooden structure that supported the walking beam. The upper component has angles measuring 205 and 155 degrees. These measurements indicate the angle for the secondary beams that supported the paddlewheel shaft. The depth of these two components measured 1 ft 6 inches, indicating the thickness of the beams.

Numerous iron rods secured the A-frame within the hull. These irons rods were tightened using turnbuckles. The placement of three of these rods can be identified on the bearing block. On each end of the bearing block's upper component, two reinforced holes ran at the same angles as the secondary beams. This indicates that each side of the bearing block contained a rod that ran down the sides of the A-frame. A large shackle secured to the lower portion of the bearing block contained a short rounded stub with a 1 inch diameter. The stub indicates that another securing rod broke off from this location. The shackle allowed the former rod to descend at a wide angle toward the side of the vessel.

Excavations recovered two wrought iron turn buckles of which one was smaller and the other heavily constructed. The smaller of these turn buckles measures about 3 inches wide across the buckle (Artifact 133-034). Due to the smaller size, this artifact may have supported *Westfield*'s smoke stack rather than the engine (Figure 113). The A-frame required substantial reinforced rods and turnbuckles to counteract the forces of the constantly moving engine. The larger turn buckle (Artifact 117-002) measured 1 ft 8 inches long, 6 inches wide, and 2 inches thick. Attached to each end of the buckle, several feet of the securing rod survived (Figure 114). Like the stub on the bearing block shackle, the rod has a diameter of 1 inch. Numerous other wrought iron rod fragments were recovered. All of these artifacts contained hexagonal nuts that were threaded onto the rods. Interestingly, some of the threads on these wrought iron rods are brass. Artifact 133-053 contains a heavily eroded nut that allows parts of the brass threading to be inspected (Figure 115). This brass bushing prevented the nut and bolt from rusting together, therefore allowing tightening or loosening as needed.

Walking Beam

The Memphis drawing (Figure 3) offered considerable information about *Westfield*'s walking beam. The artist spent great efforts to detail the internal cast iron skeleton with all the numerous arms and reinforced ridges. Based on the drawing, the walking beam measured 22 ft wide by 12 ft tall. Another source of potential information can be found in *Westfield*'s sister ship USS *Clifton*. Said to be "equal in every respect", both were built simultaneously at the Simonson Shipyard. The main difference lay in the iron works companies that built the engines. Morgan Iron Works built *Westfield*'s engine, while Allaire Iron Works constructed *Clifton*'s engine. However, both engines had cylinders 50 inches in diameter and having a 10 ft stroke.

Like *Westfield*, *Clifton* sank in Texas during the Civil War. Salvage operations recovered *Clifton*'s walking beam during the early 20th century (Figure 116). In 2012, this artifact underwent conservation at the CRL. During conservation, measurements recorded from *Clifton*'s walking beam were smaller than those indicated by the Memphis drawing, at 20 ft wide by 9 ft tall. This difference in size may be an issue of artistic interpretation or engine manufacturers. Since the vessels were built at the same time and designed for the same engine, a difference in walking beam size is unlikely. Evidence from an artifact is more reliable than a drawing; therefore, *Westfield*'s reconstruction follows the dimensions of *Clifton*'s walking beam.

Missing Components

There are still many remaining components of *Westfield*'s walking beam engine that did not survive archeologically and have not been revealed in the historical record. Some of these missing components were logically restored based on the proportions of surrounding engine parts. Others must be conjecturally reconstructed based on other examples.

The missing crank arm was briefly mentioned above in the section on engine proportions. As discussed, the length of the crank arm, or the "throw of the crank," measured exactly half of the piston stroke. This measurement was taken from "center point to center point" and did not account for the thickness of the paddlewheel shaft or the hub for the connecting rod. Paddlewheel shafts generally had a diameter between 12 inches and 16 inches (Whittier 1983:13, 15). *Westfield*'s shaft was reportedly 13 inches in diameter (Galveston Daily News 1899). Based on *Westfield*'s 10 ft engine stroke, the crank arm measured 5 ft "center point to center point", and approximately 6 ft long "edge of paddlewheel shaft to edge of connecting hub". The extra 1 ft was conjectural, but required consideration to ensure that the full thickness of the crank arm completed a full rotation without hitting the lower bed frame.

Based on the position of the paddlewheel shaft and crank arm in relation to the reconstructed A-frame and walking beam, *Westfield* required a connecting arm approximately 26 ft 6 inches long, center point to center point. On the opposite side of the walking beam, the connecting links that reached down to the piston rod necessitated a length of 11 ft 6 inches long, also center point to center point.

A rule may have existed to determine the offset for the eccentric circle at the paddlewheel shaft, and the length of the arm necessary to adequately "rock" the rocker arm. For purposes of this reconstruction, the length of the eccentric arm was restored to an approximate 25 ft length to allow the arm to reach from the paddlewheel shaft to the rocker arm.

The remaining components included the steam chest, the engineering controls, and the number of supporting struts for the crosshead channel. Without more information, these final elements must be left to conjecture. The placement of these elements on the reconstruction simply attempts to mirror those found on other plans.

Unidentified Machinery

In addition to artifacts that are known to have come from *Westfield*'s walking beam engine, excavations recovered other machinery components that remain unidentified. Some of these artifacts may have come from the engine, others may been utilized in machinery elsewhere on the vessel.

Just south of the firebox on what would have been *Westfield*'s starboard side, recovery efforts found a unique object (Artifact 40) shaped like a quarter moon with a larger flat edge (Figure 117). The poor state of the metal was beyond saving, yet conservators successfully made a mold and resin copy of the original to allow for study. This artifact was made of cast iron and contained a unique curve along the length. The curve prevented the object from lying flat. On the rounded edge, an indentation was molded at the time the artifact was manufactured. This indention may have allowed the artifact to be easily removed from another object. How this artifact was used remains unclear.

On the port side of the vessel, outside the area believed to have been the main cabin, a large cast iron artifact was recovered (Artifact 106-004). This artifact is one of the largest pieces of machinery recovered from *Westfield* (Figure 118). Comprised of two components, the artifact was designed to accommodate a heavy load. A flat base measuring 22 x 18 x 1 inch contains a central hole with a reinforced upper ring. The central hole supports a cylindrical shaft that once rotated. The top of the shaft contains three fins, each with a small one inch semi-circular hole at the bottom. Below the base, the shaft changes shape and becomes square. This square portion may have been a key that engaged into another part of a larger machinery assembly. Although the exact purpose of this machinery is not clear, the evidence suggests a rotating winch of some sort. If the artifact's recovered location remains close to where it was originally used, the provenience suggests that the object may have once been part of steam driven capstan utilized for the rear anchor chains.

Artifact 129-002 is an unidentified cast iron machinery piece that has many diagnostic features (Figure 119). In general appearance, the artifact looks like a rounded pad that fit over another curved object. The other missing object clearly rotated and over time wore down the artifact's lower surface and one of the sides. All of the wear marks are radial and very smooth. However, the wear pattern is uneven, suggesting that the artifact may have been out of calibration with the other piece of machinery. Looking at the artifact from either side, the artifact originally appeared to have identical ends. Now one end is quite thinner than the other. The top of the artifact contains the embossed numbers "313" and "0". There are also several curved mounting points on the top ends, as well as a raised opening at the top center. These features imply that another object slid through the opening and lay down into the mounting points. Despite that numerous components on walking beam engines rotated, there does not seem to be any equivalent to this artifact on existing plans. How this artifact was used, and to what piece of machinery it belonged, remains unclear.

FIGURE 117. UNIDENTIFIED MOON-SHAPED MACHINERY COMPONENT (ARTIFACT 40)

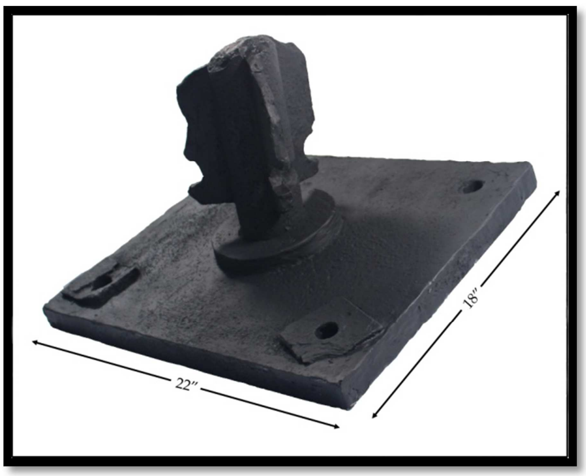

FIGURE 118. UNIDENTIFIED MACHINERY - POSSIBLY STEAM DRIVEN WINCH OR CAPSTAN COMPONENT (ARTIFACT 106-004; SCALE INCHES)

FIGURE 119. UNIDENTIFIED MACHINERY COMPONENT WITH EMBOSSED "313" (ARTIFACT 129-002)

FIGURE 120. UNIDENTIFIED CAST IRON PEDESTAL-LIKE OBJECT (ARTIFACT 132-001.51)

One of the first artifacts conserved by CRL was a pedestal-like artifact made of cast iron (Artifact 132-001-51). The main body of the artifact is heavily constructed, rounded on two sides, and contains a central mounting hole for a recessed square headed bolt (Figure 120). On the bottom side of the object, two projecting ridges indicate that the artifact sat on another object that likely contained dual recesses to receive the artifact. The ridges on the artifact likely sat within those recesses to prevent sliding, and the upper recessed bolt secured both objects together. Based on tiny fragments of wood recovered from the recessed bolt hole, conservators believe the other object was made of wood. Branching off from the wider rounded side of the artifact, a unique rim shape contains a reinforced mounting hole for another unknown object. How this object was used is unclear, but the heavy construction and reinforced features indicate it may have been a part utilized in machinery.

Artifact 132-001.59 contains many features to suggest the object may have been a three part bearing block for a larger piece of machinery (Figure 121). The artifact appears to be the lower base for an object consisting of two components. Four hexagonal bolts near the center likely joined the artifact to the now missing top portion. The interior is hollowed out in a rectangle that follows the shape of the exterior. Across the hollowed out center, there are three semi-circles on each outside

wall. If this object was a bearing block, then the missing upper section likely also contained these semi-circles to secure the objects that the artifact intended to bear. The outer semi-circles are smaller and both still retain axel-like objects and rollers that are now fused to the main artifact. Both of these axels and their associated rollers are wrought iron. The center larger semi-circles are open, indicating that the object they supported is now lost. The surviving axels and rollers may have assisted in rotating a belt of some sort through the machinery. Without more of the original machinery to which this artifact belonged, the exact function remains speculative.

Boilers

During the mid-20th century, numerous types of boilers were utilized in maritime navigation. Out of these designs, the return flue boiler was perhaps the most commonly used in the United States, because the design was simplistic and relatively easy to maintain. In return flue boilers, the firebox generally consisted of one or more furnaces arranged side by side (Figure 122). The furnaces were divided by cast iron bars creating an upper and lower section. The top section was where the fuel was placed and the fire burned. This upper portion was accessed through a hinged port, known as the "fire door". Behind the door, the bars, known as "fire grates" were laid out perpendicular to the boiler's front and angled slightly downward towards the back of the boiler. Typically the fire grates were packed together in two rows (smaller boilers had one row) with only enough room between them to allow for heat expansion. Three long cast iron bars known as "bearing bars" supported the two rows of fire grates. The forward bar was called the "dead plate", while the other two were simply referred to as the middle or rear bearing bars. The lower section of the furnace was called

FIGURE 121. UNIDENTIFIED SMALL BEARING BLOCK
(ARTIFACT 132-001.59)

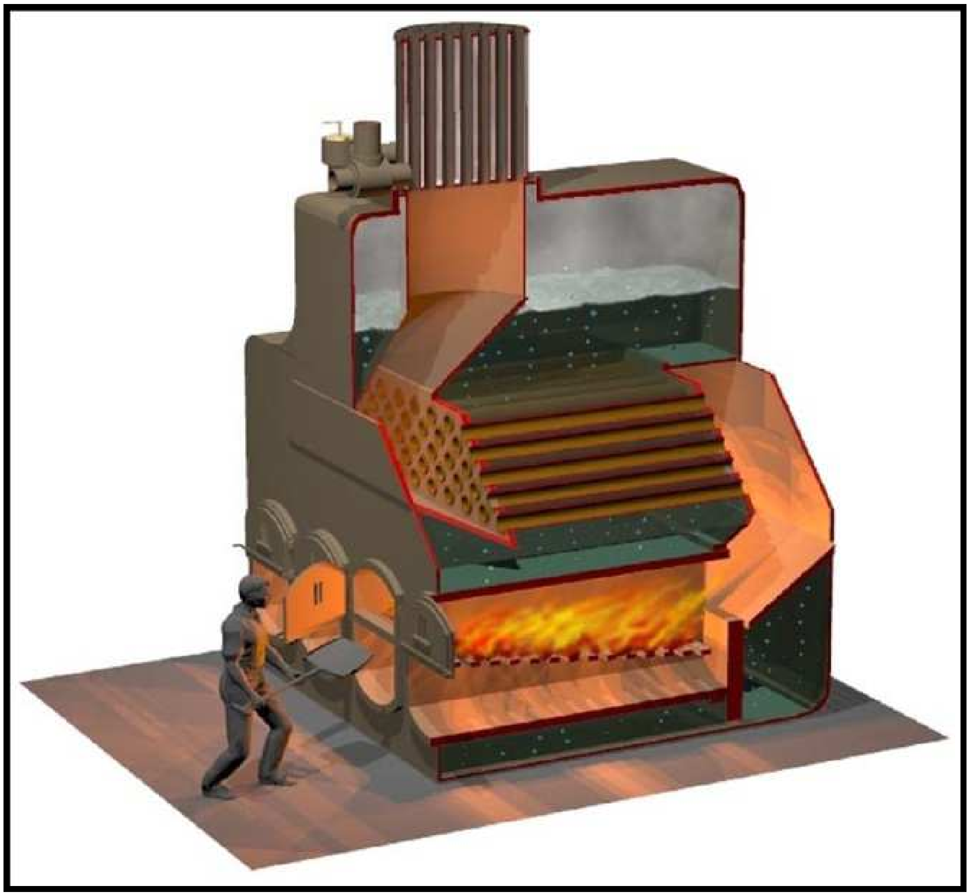

FIGURE 122. CUTAWAY OF RETURN FLUE BOILER FROM THE BLOCKADE RUNNER *DENBIGH*
(IMAGE COURTESY OF ANDREW HALL AND THE INSTITUTE FOR NAUTICAL ARCHAEOLOGY)

the ash pit. Spent fuel fell through openings in the fire grates and collected within this area. Some, but not all, boilers contained a door over this opening as a means to help control the fire's draft.

Heated gases from the furnaces left the firebox and traveled through large flues within a rear tubular section of the boiler, known as the "boiler barrel". Near the back of the barrel, the flues joined together in a combined space or "combustion chamber". This space allowed for further combustion of the fuel, which aided the heat transfer in the back of the boiler. The heat travelled upwards within this chamber, before returning to the front of the boiler, through a series of smaller flues, known as "fire tubes". The remaining heat, gases, and any residual burning ash evacuated upwards out of the boiler through a chimney flue, and finally away from the vessel through the smoke stack. The smoke stack served two functions. The first being that the stack created a high point above the boiler, which enhanced the draft of the fires. The taller the stack, the more powerful the draft. This draft pulled or ripped the heated gases through the boiler, ensuring that the heat made contact with all the desired transfer points. The second function of the stack, allowed the smoke and any remaining burning embers to be carried away from the vessel at a safe height. This was also aesthetic, in that the stack prevented the smoke and ash from staining a vessel's painted woodwork.

The boiler barrel was filled with water to a level ideally 12 inches above the fire tubes (Bartol 1851:1). Heat transferred from both the lower flues and the upper fire tubes into the water, eventually bringing the water to a boil. Steam gathered in the upper portion of the barrel and travelled into a higher drum, where the steam could be released to the engine through the main steam pipe. As technology improved, boiler manufacturers discovered additional ways to maximize the heat transfer into the water. Like the flues, fireboxes eventually became encased in water on several or all sides. This encasement covered the front of the firebox, as well as portions of the rear firebox wall that lay outside the diameter of boiler barrel. This was achieved by securing a water tight encasement or "water jacket" around the surfaces intended to transfer heat. Constructed in the same manner as the furnaces, the water jacket incorporated numerous iron sheets, riveted together. Staybolt fasteners secured the furnace walls to the outer jacket. Fireboxes that utilized jacket encasements can be broken down into two classifications, dry-bottom boilers and wet-bottom boilers. On dry-bottom boilers, the water jacket terminated at lowest level of the firebox. This created a series of water filled legs at the boiler's base, typically one on each side of the boiler, and one dividing each furnace. Although this type of encasement was very common, very little water circulated within the legs leading to a buildup of sediment and corrosion. To prevent this, engineers often filled "the legs with cement to a depth of 10 or 12 inches above the bottom, or up to a height of the level of the grate" (Unidentified 1902:521). Wet-bottom boilers also contained water legs, but improved circulation by continuing the water jacket underneath the furnaces. Each furnace contained rounded lower edges which helped facilitate the movement of water, and prevented sediment build up in any one location. This effectually enabled the firebox to float within the front of the boiler and to disperse heat to all six sides of the box.

Most return flue boilers in the mid-19th century operated at pressures between 40-50 pounds per square inch (Whittier 1983:18). Although considered low pressure, in the event of a rupture or distortion, that amount quickly could become dangerous if multiplied to account for all of the space within a large boiler. To prevent distortion, boiler manufacturers tried to limit the amount of flat plates on a boiler. Rounded plates such as those found on the outer shell of the boiler drum, or the top of the firebox, maintained their shape as they expanded under pressure. However, the front and back portions of the firebox, as well as the back of the boiler barrel were flat. Under pressure, these plates could easily expanded outward, buckle, and rupture, leading to a boiler explosion. To prevent this occurrence, staying devices were utilized throughout the boiler on flat surfaces or other areas that were considered to be under heavy strain. These staying devices created an internal web of crisscrossing bars that enabled the boiler to safely expand or contract without jeopardizing the shape of its plates.

Hinged doors were built into the front of the fireboxes for accessing non-pressurized areas housing the fire grates and ash pits. Other doors were required to access the front portion of the upper fire tubes and the bottom of the rear combustion chamber. Those doors were within the draft zone from the boiler's fires and only could be utilized for cleaning purposes when the boiler's fires were extinguished. Opening doors to the fire tubes or combustion chamber when the boiler was in operation would have created an immediate (and possibly deadly) evacuation point for heated gases.

Additional access to the boiler's interior was achieved through "hand holes" and "man holes". These openings facilitated access to areas of the boiler normally under pressure where water was held or steam collected. To withstand the pressure, both of these opening types utilized heavily constructed cast iron cover plates. The plates were mounted from the boiler's interior and held in place by an inner lip that projected out of the hole, thus preventing the plate from sliding out of position. Around the lip, a heavy rubber gasket ensured a tight seal when under pressure. A bolt passed through the back center of the plate, forward out of the boiler, to an arched handle. The handle was tightened down against the outer boiler wall by a securing nut. When the handle and nut were in place, the cover did not move. These covers were elliptical in shape, so that when not under pressure, the plate could be removed and passed through the hole to the outside of the boiler.

Hand holes and man holes were needed for routine maintenance, because over time sediment and scale built up in crevices and on top of the flues. If such debris was not periodically removed, corrosion could damage the internal components of the boiler. Hand holes were used as small cleaning ports for removing sediment with long scrapers, rods, or brushes. Typically, these holes were placed at all corners of the firebox, on the water legs, and within the spandrels above the furnaces. Man holes allowed a crewman to physically enter into the water and steam chambers of the boiler. These entry points were commonly placed at the top of the boiler barrel, the back of the boiler barrel, or sometimes at the widest point of a spandrel between the furnaces. Upon entering the boiler, navigating from one point to another was a very difficult job due to the numerous staying devices that crisscrossed the interior. One fireman once recorded: "Being a slim lad, one of my duties was to creep into the boilers through the manhole, which was just large enough to let me through; and with a hammer and a sharp-linked chain I must "scale" the boilers by pounding on the two large flues and the sides with the hammer, and sawing the chain around the flues until all the accumulated mud and sediment was loosened. Scaling boilers was what decided me not to persevere in the engineering line. To lie flat on one's stomach on the tip of a twelve-inch flue, studded with rivet heads, with a space of only fifteen inches above one's head, and in this position haul a chain back and forth without any leverage whatever, simply by the muscles of the arm, with the thermometer 90 degrees in the shade, was a practice well calculated to disillusion any one not wholly given over to mechanics" (Merrick 1909:37).

Westfield's Boilers

Archival evidence has not been recovered that documents firsthand information on the type or number of boilers aboard *Westfield*. However, one firsthand account from USS *Clifton* implies that the vessel had two boilers. A letter from Acting Lieutenant E. H. Baldwin, to Commander D. D. Porter, of the Bomb Flotilla, refers to battle damage sustained to *Clifton*'s “starboard boiler” and mentions how the damaged boiler would be out of service for ten days and as result the vessel could only make six knots. This statement is a clear indication that there was still a second functioning boiler. A second letter to Flag-Officer D. G. Farragut confirms this information, where Porter provides an update to his superior that *Clifton* was “temporarily repaired” and now “working under one boiler” (The House of Representatives 1863:396,410).

Since the first *Westfield* and *Clifton* were built together at the same time, and following the same design, it is reasonable to assume that both vessels contained the same type and number of boilers. Secondary source information from a British naval engineer offers that both *Westfield* and *Clifton* utilized dual return flue boilers. The engineer writes about both vessels stating: "They were 224 ft long, 34 1/2 ft beam and 13 ft deep, tonnage 977 tons. They had a single beam engine, cylinder 50 ins. diam. by 10 ft stroke, paddle wheels 22 ft diam. by 9 ft face; two return flue boilers, grate surface 97 sq. ft, heating surface 2706 sq. ft, steam pressure 30 lbs., cutoff at half stroke, revo. 26 per min., speed 16 miles an hour" (Main 1893:133). Most of this information closely follows what archeologists believe to be true about *Westfield*. Archival evidence offered that *Westfield*'s lower hull measured 213 ft 4 inches x 34 ft x 12 ft 11 inches at 891 tons (see copies in Appendix A-1). Only after rescaling a lines drawing of *Southfield II* to fit these measurements, were archeologists able to determine that *Westfield*'s overall superstructure measured 225 ft. These measurements only differ from Main's measurements by minor proportions of a foot or less. This suggests that Main had access to reliable information and therefore his statement about *Westfield* and *Clifton*'s boilers is likely trustworthy.

Main's reference that the boilers used were of the return flue type is not surprising. *Westfield* and *Clifton*'s later replacements, *Westfield II* and *Clifton II*, both contained a single large return flue boiler. *Westfield II*'s single boiler was mentioned followed a rupture that caused a catastrophic explosion, killing many of the passengers (*Harper's Weekly* 1871; *New York Times* 1904:6; Stiles 2009:514). *Clifton II*'s boiler was extensively documented by the Navy's Chief Engineer for the Bureau of Steam Engineering. This was done after the vessel was purchased by the navy and renamed USS *Shockokon* (Isherwood 1865: plate VII). The single boiler contained three furnaces and measured 12 ft wide by 24 ft long, with a rear boiler barrel diameter of 10 ft. While this information does not clarify how many boilers the first *Westfield* contained, the information at least offers that the Simonson ferries utilized return flue boilers.

Although *Westfield* was extensively destroyed, salvaged, and cleared, the excavation offers more clues about the number of boilers. Most of the larger recovered artifacts from the wreck site are boiler related objects. Yet, the hundreds of artifacts combined barely account for one boiler, much less two. Additionally, only one firebox was recovered (Artifact 132-001; Figure 123). The recovered firebox measured 9 ft 3 inches wide and contained two furnaces. Four recovered boiler mounts (Artifacts 105-005, 119-018, 119-024, and 120-003; Figure 124), offer that the rear boiler drum contained a diameter of approximately 8 ft. These measurements indicate that the artifacts came from a much smaller boiler than the type found on *Westfield II* and *Clifton II*. Since the first *Westfield* was much larger than both of those vessels, a single boiler would not likely have been able to produce the desired amount of steam required for the engine cylinder.

The most significant and clarifying evidence comes from remnants of the fire doors and a single section of riveted plating. One mostly complete fire door (Artifact 120-063) was recovered as well as two separate fire door back plates (Artifacts 119-020 and 131-014; Figure 125). The idea of a spare fire door is unlikely, and therefore the third back plate likely came from a second missing boiler.

The section of riveted plating clarifies how the two boilers were originally joined together. Unlike other recovered boilerplates, this small fragment (Artifact NP-50) contained not only a folded riveted seam, but a reinforced underlying plate secured by square-headed bolts (Figure 126). An example of this plate can be found on an image of *Clifton*'s upper steam drum, photographed over 70 years after the vessel's sinking (highlighted in Figure 127). This image offers considerable information about how the boilers were constructed. Following manufacture, the boilers would have required individual lowering and placement into *Clifton*'s hull. Based on this image, each boiler contained half of a shared upper chimney flue. The flue fed up and out of the vessel's central machinery compartment, before connecting to the smoke stack. The two portions of the flue were joined together along a central seam, reinforced on both sides by square-headed bolts.

By this period, iron works companies often wrapped the steam drum around the upper flue as a final means to absorb heat before the remaining gases left the vessel. Additionally, this carried the steam higher, allowing excess water droplets to be removed before the steam entered the engine.

FIGURE 123. REMAINS OF LOWER FIREBOX (ARTIFACT 132-001)

FIGURE 124. BOILER MOUNT (ARTIFACT 120-003; SCALE DM)

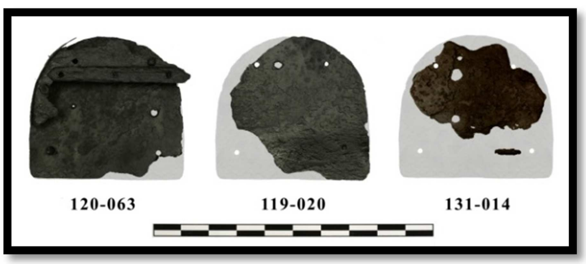

FIGURE 125. FIRE DOORS (ARTIFACTS 119-020, 120-063, AND 131-014; SCALE DM)

FIGURE 126. RIVETED PLATE FROM STEAM DRUM (ARTIFACT NP-50; SCALE INCHES)

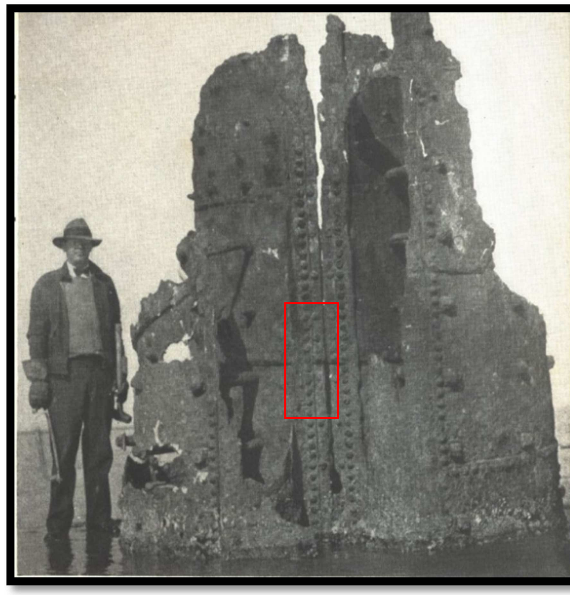

FIGURE 127. REMAINS OF USS *CLIFTON*'S STEAM DRUM (WILTON AND DIXON 1935:63)

FIGURE 128. MASSIVE STAYBOLTS FROM UPPER STEAM DRUM (SCALE INCHES)

Numerous large staybolts from *Westfield*'s wreck site indicate that the vessel utilized this type of steam drum (Figure 128). On the *Clifton* image, rather than completely encircling the flue, the plates of the steam drum abruptly curve inward, and are securely riveted down before reaching the reinforced central seam. This indicates that each boiler utilized a separate steam drum compartment. While the other side of the drum cannot be seen within the image, the arrangement was likely identical to the one found on the front. This would have created two distinct semi-circular steam compartments.

Reconstructing the Remaining Boiler

Historic charts indicate that part of the boilers remained visible above water for several years following the war, finally sinking out of sight during a hurricane in 1886 (Ziegler 1938:240). Like *Clifton*, this exposed portion of the boiler likely consisted of the upper flue and steam drums. Descriptions of the *Westfield* explosion do not recount the destruction of the boilers, although a second explosion might be alluded to in one account. That eyewitness recounted years later that "the machinery had not been destroyed, as the singing of the steam was distinctly heard after the explosion . . . for ten minutes, when there was another flash, and she was speedily wrapped in flames" (Scharf 1894:508). If Commodore Renshaw chained down the boiler safety valves as was described (Bosson 1886:112, *Boston Journal* 1863:2, *New York Times* 1863), the boilers would have eventually ruptured leading to at least partial destruction or deformation. This damage may have been extensive, but not enough to account for the disarticulation of the boiler artifacts that were found widely dispersed across the site. Clearing of the site by the USACE in 1906, which included the use of explosives, may account for this disarticulation, and the complete destruction of at least one of the boilers. The limited number of the boiler artifacts that remained, and the absence of a second firebox, implies that the other boiler was removed from the site during that time.

From the artifacts that were recovered, enough diagnostic features survived to offer an understanding of how *Westfield*'s boilers were constructed. These include the firebox, a portion of the flues, fire grates, internal staying devices, various door types, cleaning hatches, and numerous types of riveted metal plates that represent different parts of the boiler.

Aside from boiler plating, the most abundant recovered boiler artifact consisted of internal staying devices. Due to the extreme pressures within the boiler, the internal structure incorporated many strengthening devices such as staybolts, and longitudinal and vertical supports. Figures 129 and 130 illustrate a replacement tubular flue boiler manufactured in 1902 for the U.S. revenue cutter *Perry* (unidentified 1902:522-523). The boiler was unique as, at the time of its construction, the return flue boiler had been supplanted by newer or more-effective models such as the Scotch marine boiler and water tube boiler (Peabody and Miller 1894:9–10; Sheret 1997:31–34). The boiler for *Perry* was a modernized interpretation of the older boiler style, yet it incorporated the same design features and has helped identify artifacts from the *Westfield* site. Most of the recovered staying devices consist of staybolts and "crow's foot" fasteners.

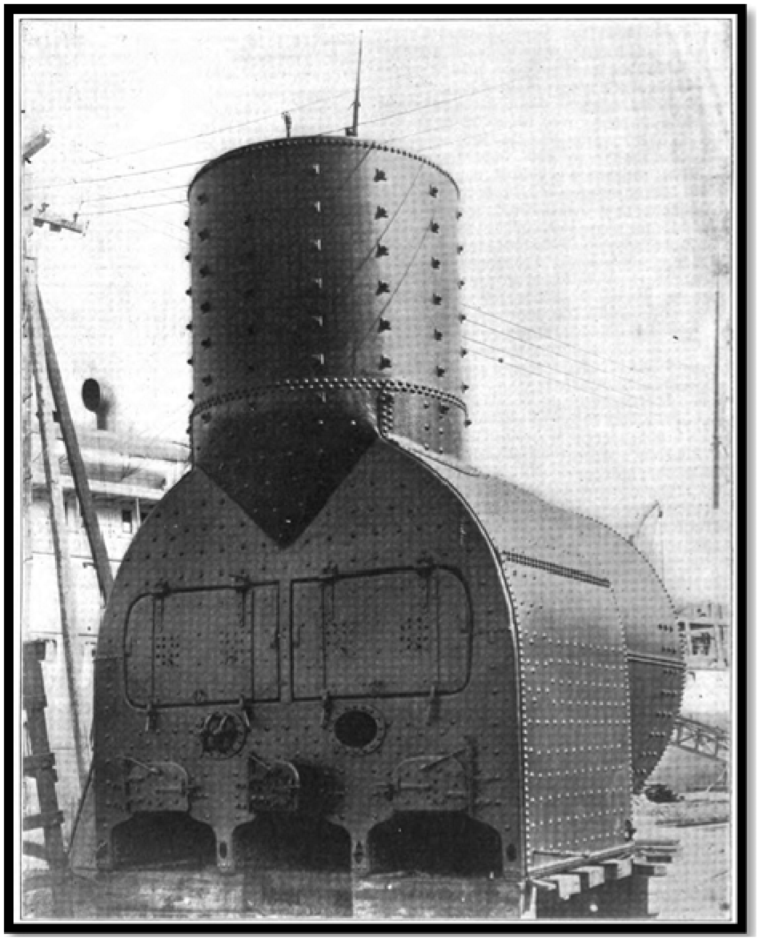

FIGURE 129. RETURN FLUE BOILER FROM REVENUE CUTTER *PERRY*
(UNIDENTIFIED 1902:523)

The crow's feet came in several variations. The majority are of the single type. These were made out of two pieces of rectangular boiler iron that were bent into a "T" shape. The object was riveted to a surface and then a staying rod with end loops was place over the device. To secure the rod, a bolt was passed through the loops and the shaft of the "T" (Figure 131). Another type incorporates two longer boiler straps that were folded down on all four ends, creating a double crow's foot in the shape of a handle (Figure 132; Peabody and Miller 1894:92). Several larger plates believed to have come from the lower portion of the chimney flue, utilized a large number of these double crow's feet (Figure 133). These handle-like staying devices received vertical support rods attached to the crowns of the furnaces and the longitudinal supports that ran the length of the boiler. Another example consisted of a double crow's foot, that was shaped like the cross section of an "I" beam. A large number of these supported heavier objects in the boiler.

The most complex object recovered is the base of the firebox (Figure 123). When the firebox was documented in 2006, the fire grate assemblage had collapsed downward into the ash-pits due to corrosion on the wall tabs that once supported the bearing bars. Despite this, the entire assemblage of both the fire grates and the lower bearing bars remained intact in the same manner as when they were originally in use (figures 134 and 135). Only one quadrant of grates had shifted from their original position. This could have been due to either corrosion on the outer furnace wall or from damage during the 1906 demolition operations. The remarkably intact assemblage suggests that the box lay relatively undisturbed since the vessel's sinking. The firebox consisted of two furnaces, each measuring approximately 6.3 x 4 ft that were connected to one another and to the outer water jacket by a series of staybolts spaced 8.25 inches apart horizontally, and 7.25 inches apart vertically. This arrangement created three water legs, one between the furnaces, and one on each

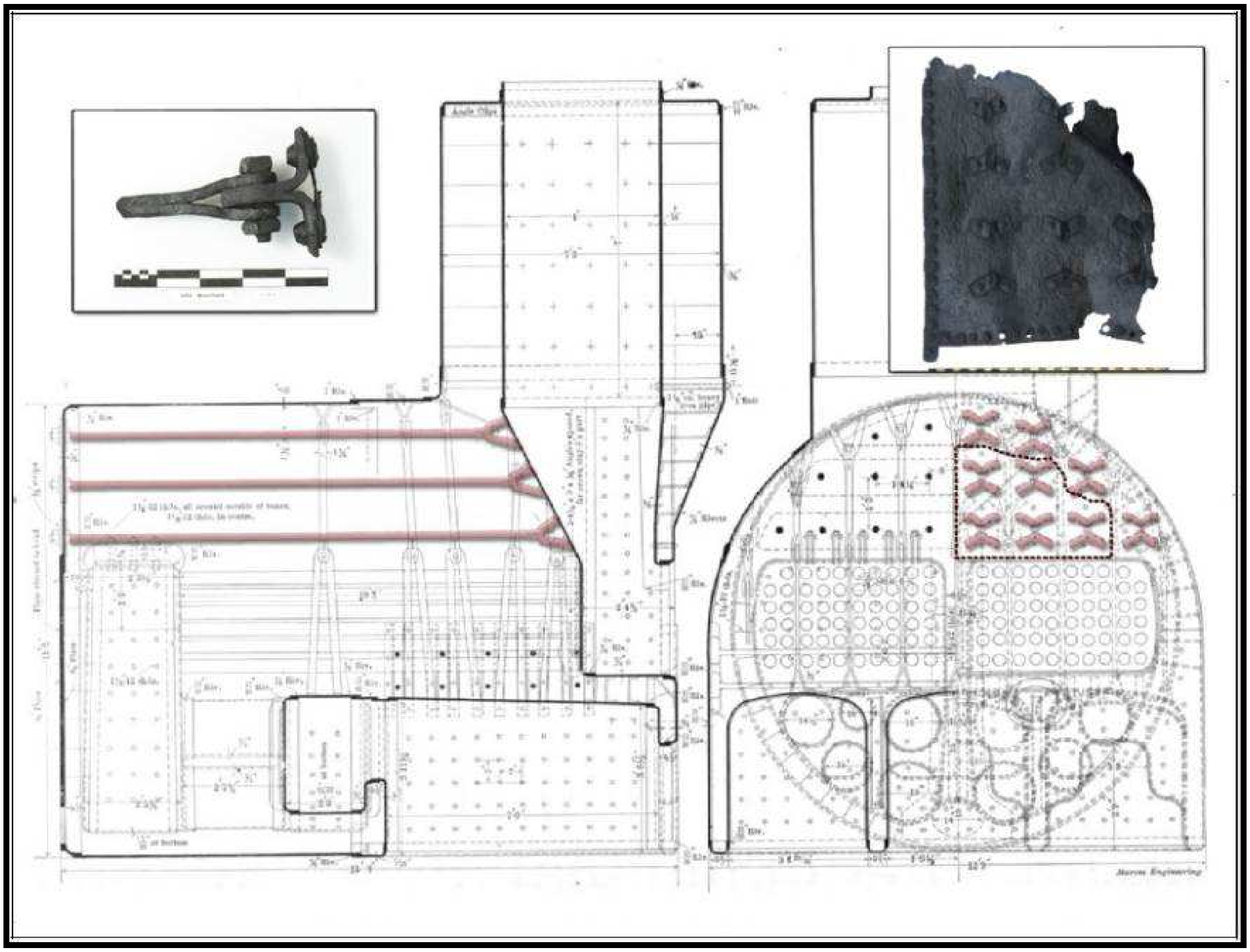

FIGURE 130. INTERIOR SCHEMATIC OF STAYING DEVICES WITHIN *PERRY*'S BOILER
(THE ARTIFACTS IN THE UPPER LEFT AND RIGHT ARE FROM *WESTFIELD;* UNIDENTIFIED 1902:522)

side of the firebox. During the recovery, the far right water leg broke off just above the lower curve on the firebox. This artifact (132-001.79) was conserved as a large representative example to show how the staybolts connected the furnace wall to the outer water jacket (Figure 136). Underneath the furnaces and the water legs, the staybolts transitioned to double-ended crow's foot fastener brackets. These brackets were spaced similarly to the staybolts and were secured by four rivets,

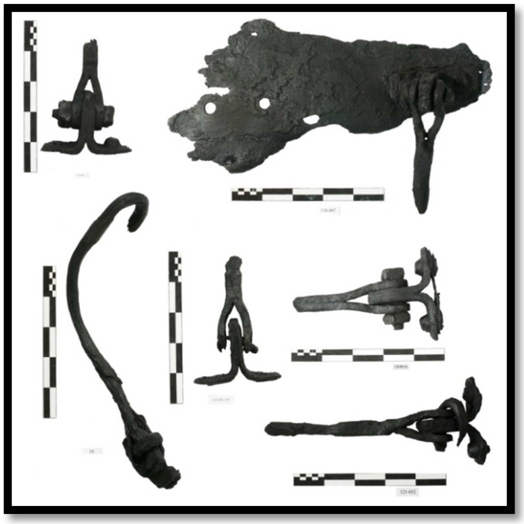

FIGURE 131. CROW'S FOOT STAYING DEVICES

FIGURE 132. DOUBLE CROW'S FOOT, HANDLE-SHAPED WITH HOOKED RECEIVING ROD (ARTIFACT 132-001.49)

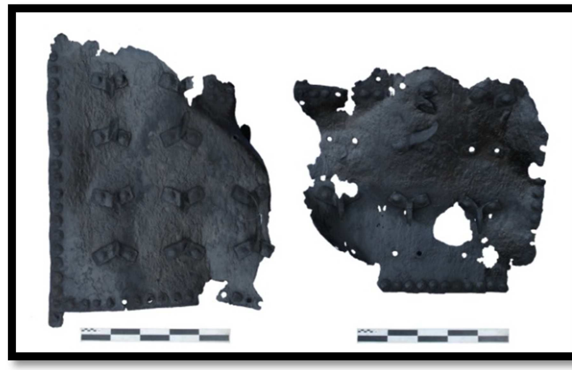

FIGURE 133. PLATES WITH DOUBLE CROW'S FOOT HANDLE ATTACHMENTS (ARTIFACTS 109-003 AND 121-013; SCALE CM/DM)

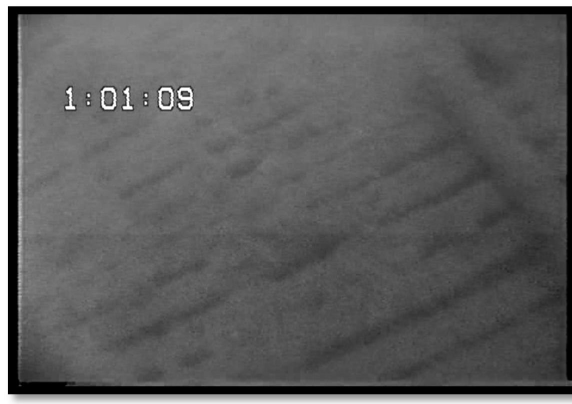

FIGURE 134. UNDERWATER IMAGE OF FIRE GRATES *IN SITU*

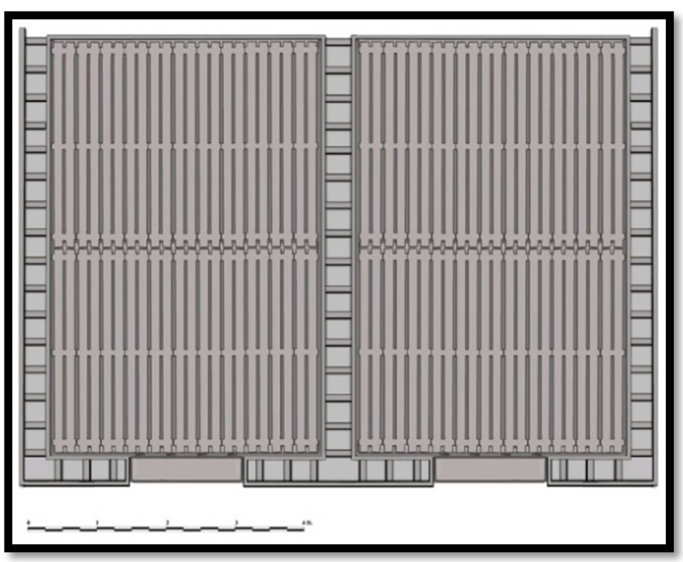

FIGURE 135. RECONSTRUCTION OF FIRE BOX WITH ROWS OF FIRE GRATES AND FORWARD BEARING BARS (DRAWING BY AMY BORGENS AND JUSTIN PARKOFF)

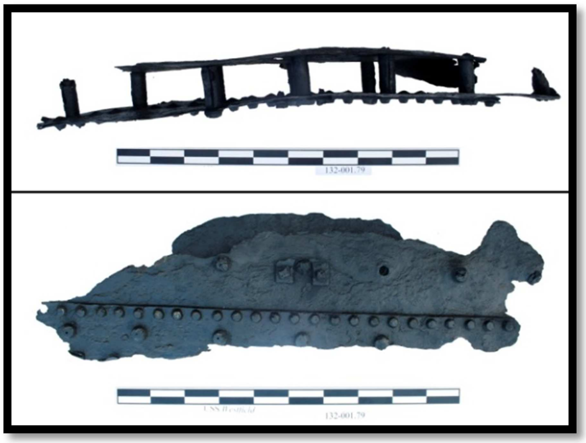

FIGURE 136. RIGHT WATER LEG OF BOILER (ARTIFACT 132-001.79; SCALE DM)

FIGURE 137. DOUBLE-ENDED CROW'S FOOT FASTENER (ARTIFACT 132-431; SCALE CM)

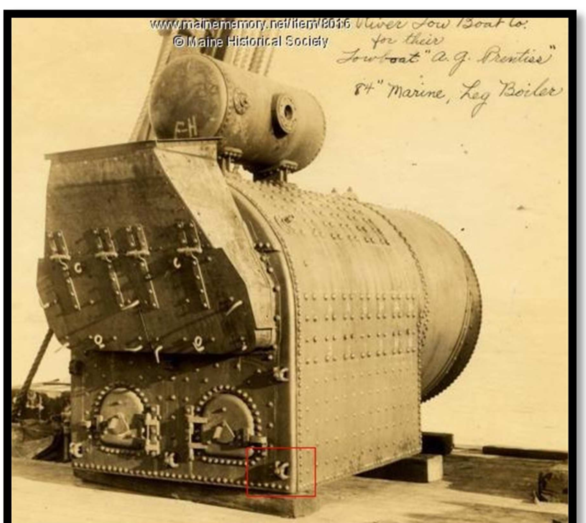

FIGURE 138. EXAMPLES OF HAND HOLES ON WATER LEGS (IMAGE BOILER FROM *A. G. PRENTISS*, COURTESY OF THE MAINE HISTORICAL SOCIETY)

FIGURE 139. SMALLER SIZED HAND HOLE CLEANING COVER (ARTIFACT 132-001.55)

FIGURE 140. MEDIUM SIZED HAND HOLE CLEANING COVER (ARTIFACT 118-178)

FIGURE 141. LARGER SIZED HAND HOLE CLEANING COVER (ARTIFACT 120-053; SCALE CM)

FIGURE 142. MAN HOLE ACCESS HATCH INTO BOILER (ARTIFACT 122-042; SCALE CM/DM)

two on top and two on bottom, to join the outer water jacket to the bottom of the furnaces (Figure 137). The transition to these fasteners was likely necessary to prevent the furnaces from shifting under the weight of the fire grates, which may have happened if the furnaces stood on top of cylindrical staybolts, rather than flat-surfaced brackets.

To access different parts of the water jacket surrounding the firebox, numerous "hand holes" were placed, that permitted occasional cleaning. Exactly where these hand holes were placed is speculative. Yet as mentioned earlier, convenient placements would have positioned many on the corner edges of the firebox, in between the water legs, and in the spandrels above the furnaces (Figure 138). The plate on the hand hole could be removed when the boiler was not pressurized. This was done by unthreading a nut and removing the securing handle. Three different sizes of hand hole cover were recovered. The smallest measured 6-3/8th inches by 4-3/8th inches. While the cast iron was in relatively good condition, the wrought iron handle did not survive (Figure 139). The middle size measured 7-5/8th inches by 5-5/8th inches. This type used a double-arched handle, which when facing looks like an "X" (Figure 140). The larger size measured 10-1/8th inches by 7-5/8th inches. The handle on this version was singular, consisting of only one arch (Figure 141).

A similar, yet much larger version of these artifacts was known as a "man hole." This artifact type permitted physical human access into the boiler's interior. Two of these large artifacts were recovered (Artifacts 119-019 and 122-042). In general appearance, man holes resembled hand holes, but were considerably more reinforced (Figure 142). The back plates measured 14.5 inches by 12 inches. Both of the recovered man hole covers contained a single arched handle. Rather than just relying on the handle to secure the covers in place, the entire back plate was secured against a thick wrought iron lip that was rivet down on the boilerplate. One of these man hole covers (Artifact 119-019) is believed to have come from the rear of the boiler barrel (Figure 143). The artifact still retains a large piece of boiler plating complete with a rounded strap of rivets (Figure 144). A third man hole was indirectly identified. Knowledge of the object's former presence can be found in too cast iron fragments (Artifacts 131-019 and 132-001.56) that once formed the man hole's frame (Figure 145). This missing man hole is also believed to have come from the boiler barrel, specifically on the top. Examining the artifacts, the original shape can be determined as oval. Yet, while the tops of these artifacts remain flat, their bases are arched, indicating that they were mounted to a cylindrical surface. An identical example of this frame can be seen on the boiler plan for the USS *Commodore Barney* (Figure 146).

Although the water jacket is heavily distorted, an overall front width of the boiler can be accounted for by adding the plate thicknesses together, the length of the staybolts, and the width of the furnaces. Based on core samples taken from plating that was protected, (plates that were sandwiched between other plates), the lower firebox utilized plating 1/5 inches thick. This

FIGURE 143. MAN HOLE ACCESS HATCH FROM REAR BOILER BARREL (ARTIFACT 119-019; SCALE DM)

FIGURE 145. FRAGMENTS OF MAN HOLE FRAME FROM TOP OF BOILER BARREL (ARTIFACTS 131-019 AND 132-001.56)

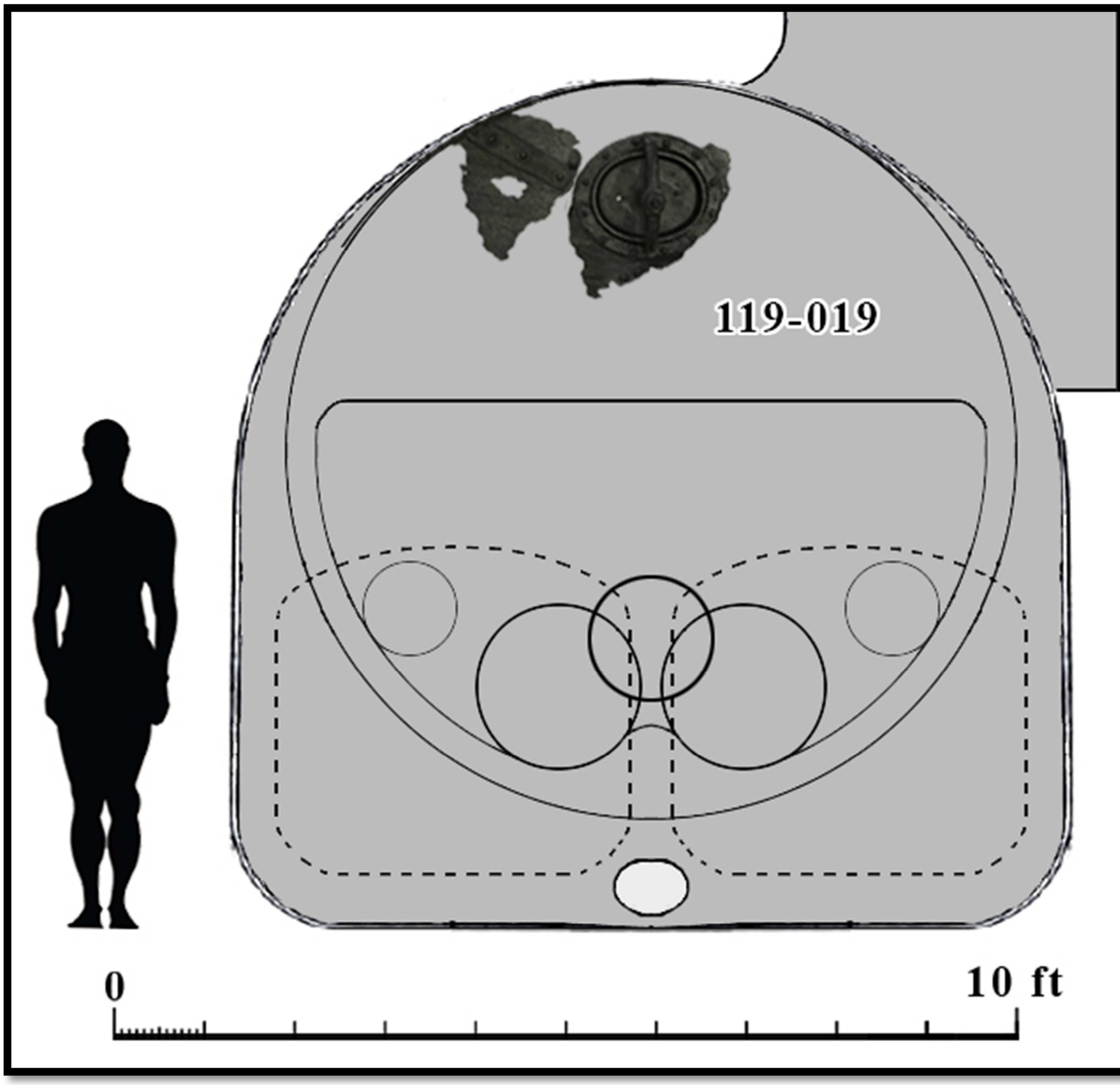

FIGURE 144. MAN HOLE ACCESS HATCH FROM REAR BOILER BARREL IN CONTEXT (ARTIFACT 119-019)

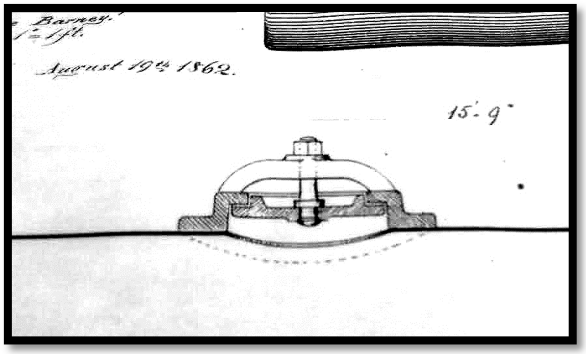

Figure 146. Boiler barrel access hatch plan from USS *Commodore Barney*

Figure 147. Examples of fire box staybolts (artifacts 132-001.64 and 132-001.67)

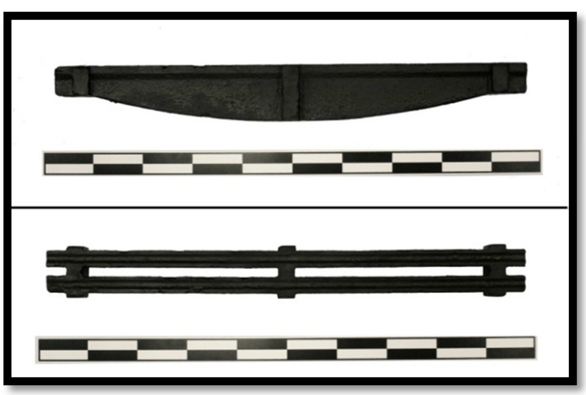

Figure 148. Example of fire grate (scale dm)

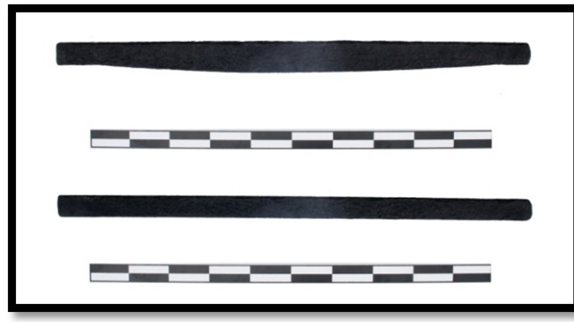

Figure 149. Example of center or rear bearing bar (scale dm)

Figure 150. Broken tab for supporting bearing bars (close up shot from water leg; artifact 132-001.79; also seen in figure 136)

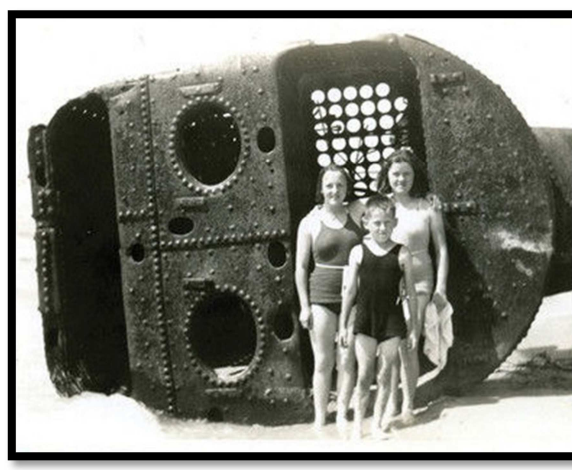

Figure 151. Boiler with separate fire door and ash pit frames (image of boiler from *Erie Belle* shipwreck; courtesy of Kathryn Houston)

thickness needs to be multiplied by 6 to account for the outer water jacket on the left and right side of the boiler, and the walls of each furnace. The staybolts on each side of the boiler contained a sleeve that evenly separated the water jacket from the furnaces. These sleeves measured 4 inches long (multiplied by 2 for both sides of the boiler). Between the furnaces, longer staybolts sleeves measured 5 inches long (see Figure 147 for side by side comparison). Both furnaces individually measured 48 inches wide. Combining these measurements, the restored front of the boiler measures 9 ft 3 inches.

Inside the firebox, each furnace contained two rows of fire grates, with 12 grates in each row (Figure 135). The grates measure 3 ft long x 4 inches wide and are 5 inches thick at the midsection, tapering to 2.5 inches at each end (Figure 148). From underneath the two rows of grates, several of the bearing bars were successfully recovered. These bars are shaped similarly to a fire grate, with the exception of being longer and solid to support a greater weight (Figure 149). Each bar, rested on tabs that were riveted on the furnace walls. The best preserved example of one of these tabs can be found on the earlier mentioned water leg (Figure 150). The lower portion of the tab is secured to the water leg with two square-headed bolts. Although broken, the tab appears to have once bent outward into the furnace to support the end of a bearing bar. How the bar stayed on the tab without sliding forward or aft is not clear.

The forward bars or "dead plates" offered a significant amount of information on how the shape of the inner fire door frames related to the lower ash-pits. On some boilers, the openings for the fire doors and the ash-pits were physically separate openings within the forward water jacket (Figure 151). On other boilers, the fire door frames and the ash-pit frames retained their necessary shapes, but connected together as a single opening, only separated by the dead plate bearing bar. The dead plate bars from *Westfield* incorporated a shelf that extended out into the water jacket (figures 152 and 135). This shelf indicates that the lower fire doors and lower ash-pits on *Westfield*'s boilers were joined and were only functionally separated by the dead plate bars. The extended shelf on the dead plate bearing bars was likely utilized as a place for the firemen to rest their shovels or stoking tools.

If the lower ash-pits were individual openings, the openings would normally adopt a flat-sided oval shape or a rectangular frame. When the lower ash-pit and upper fire door frame joined as one, the shape of the opening required a frame that merged between the two shapes. Artifact 120-279 contains a unique shape unlike any other found within the boiler artifacts (Figure 153). The top plate contains a line of rivets that are purposely placed to help fold an underlying plate into a distinct shape. The curvature of the underlying plate indicates that the artifact came from part of the outer water jacket. Based on the curvature of the riveting pattern, this artifact served a very specific purpose. The shape served as the transition point between a lower ash pit and an upper fire door frame (Figure 154). Two portions of fire door frames were recovered (Artifacts 120-002 and

FIGURE 152. FORWARD BEARING BAR WITH "DEAD PLATE" (SCALE DM)

FIGURE 153. TRANSITION PLATES BETWEEN LOWER ASH-PIT AND UPPER FIRE DOOR FRAMES (ATIFACT NO 120-279; SCALE CM/DM)

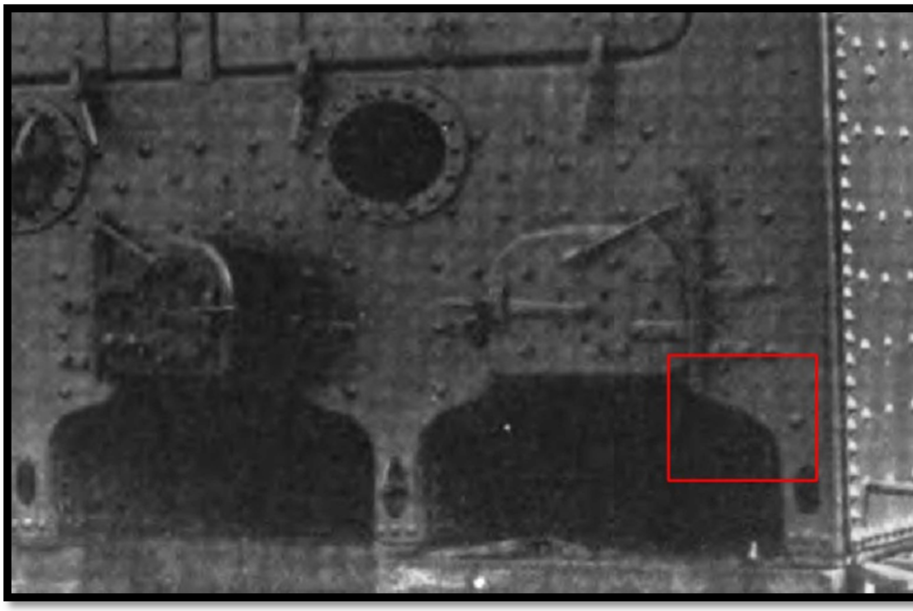

FIGURE 154. TRANSITION PLATE BETWEEN LOWER ASH PIT AND UPPER FIRE DOOR FRAME (UNIDENTIFIED 1902:523)

FIGURE 155. TWISTED FRAMES FROM UPPER FIRE DOORS (ARTIFACTS 120-002 AND 120-023; SCALE CM/DM)

FIGURE 156. RAIL ROAD IRON POSSIBLY UTILIZED AS REPLACEMENT FIRE GRATE (SCALE DM)

120-023). These artifacts follow the curvature of the fire doors, although both are twisted outwards, away from their original mounting points due to an interior explosion (Figure 155).

When the artifacts first arrived at Texas A&M University, CRL's manager, Jim Jobling (personal communication 2010) speculated that twelve recovered pieces of railroad iron may have been stored on the ship as replacement fire grates. Following conservation, three of these railroad irons revealed that they were physically cut down to 3 feet, the same length as the fire grates (Figure 156). When these vessels were in enemy waters, the crews were required to make use of the materials they immediately possessed or those that could be acquired. A single recovered railroad spike (Artifact 132-101) suggests that railroad irons were not just excess pieces, but sections that may have been removed from existing tracks (Figure 157). Scavenging while in Confederate territory was not uncommon. The journal of Henry Gusley, a marine aboard *Westfield* mentioned raiding Confederate towns for food and supplies (Cotham 2006:114). Other artifacts may have been repurposed as well.

Two larger fire grates were found within the vicinity of the firebox, but no definitive explanation could be determined on how these grates were utilized (Figure 158). Both of these grates measure 46.5 inches x 4 inches and are 3 inches thick at the midsection, tapering to 1.5 inches. These grates led to much speculation by conservators that part of the recovered firebox was missing. Yet, this could not be the case, since all of the retaining firebox walls remained relatively intact. While many other boilers incorporated rows of fire grates containing different lengths (Main 1865:52), the recovered firebox from *Westfield* suggested that all grates were the same size. Interestingly, these two mysterious grates are the same length as the normally solid bearing bars beneath the fire grates. Having no other explanation, the author speculates that these fire grates were obtained from a larger boiler and brought aboard *Westfield* to be utilized as replacement bearing bars due to their equivalent size.

As previously mentioned, three fire doors were recovered. One is considerably intact (Artifact 120-063); while the others consist of only back plates (Artifacts 119-020 and 131-014). The firebox recovered from *Westfield* had two fire doors (Figure 159). Based on the more intact door, their construction consists of a front and rear plate that are joined together with four small staybolts. The staybolts have a treaded tip on each end, which is screwed in to both plates. To prevent the plates from moving or placing too much wear on the threads, a small sleeve, similar to those found on the firebox, acts as a middle spacer. The door measures 21 inches wide by 20 inches tall, and contains a semicircular top, and slightly rounded lower edges. The outer front plate, which faced the crew is considerably damaged, and only survives along the top and left side. A single hinge remains bolted to the plate in three locations. The end of the hinge, where the pin would have been located extends off the plate without any type of downward bend. This suggests that when closed, the entire door rested on the outside of the boiler door frame. That design corresponds with

FIGURE 157. SINGLE RAIL ROAD SPIKE (ARTIFACT 132-101)

FIGURE 158. LARGER FIRE GRATE POSSIBLY REUTILIZED AS LOWER BEARING BAR (SCALE DM)

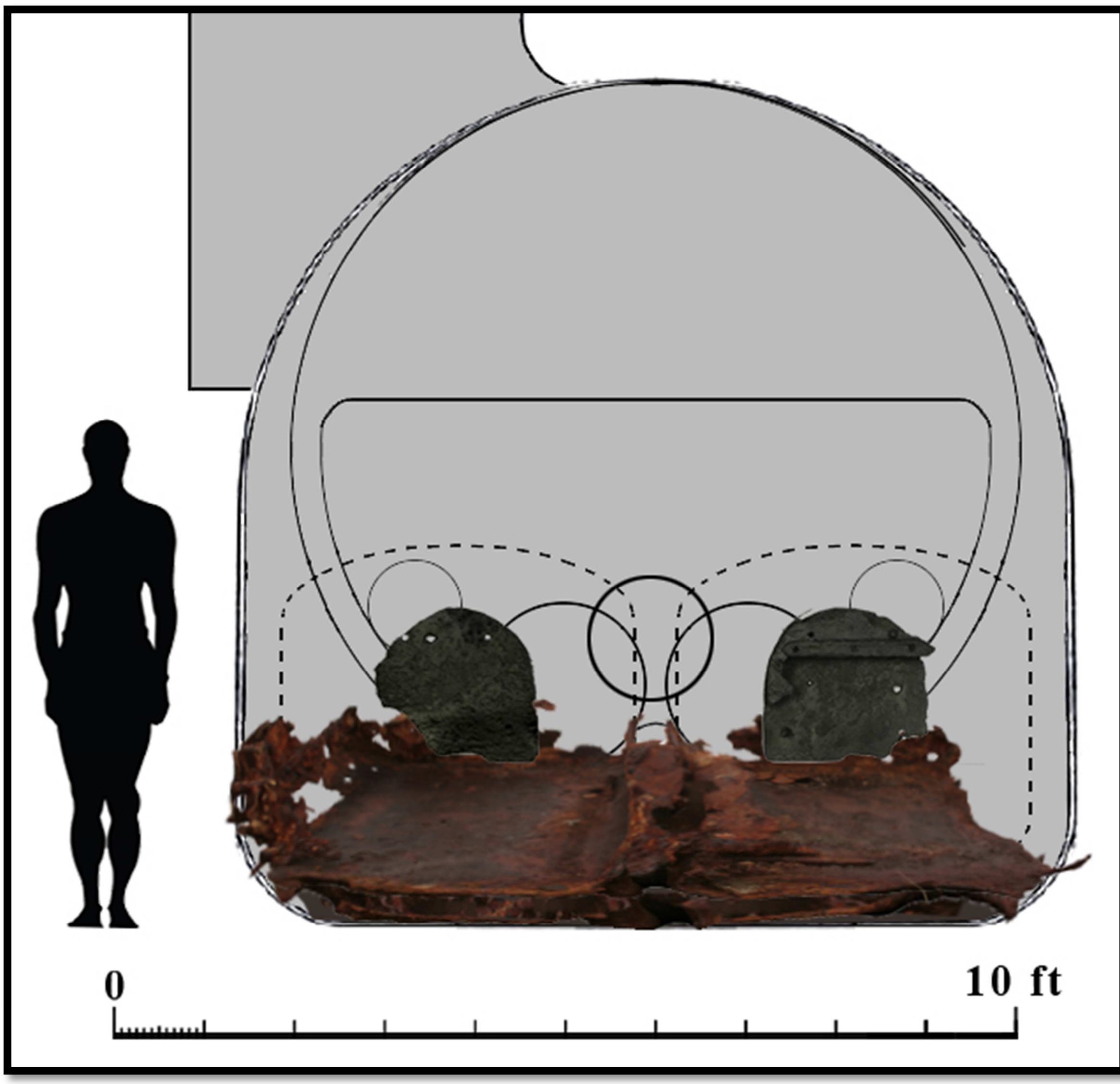

FIGURE 159. FIRE DOOR ARRANGEMENT ON *WESTFIELD*

historic photography of other fire doors. The other end of the hinge terminates near a small nut. The nut is secured to the front plate by a bolt that appears to have snapped off from the outside of the door. Just below this nut, where the front plate terminates due to damage, a semicircular hole indicates that another bolt and nut were once present. The close proximity of these objects may indicate where a bracket once joined. Based on historic photography (Figure 160), a bracket in this location would have secured the fire door lever in place.

When a crew member desired to open the door, he lifted the lever up from a securing cradle fastened to the boiler wall, and then pulled the lever and door open. One of these fire door levers was recovered (Artifact 125-006). The lever consists of an elongated bar with a lifting handle on one end and a pivot ring and inner pin on the other (Figure 161).

One fragment of a baffle plate was recovered (Artifact 119-197). This small fragment is made of cast iron, and is pierced by numerous holes that facilitated draft (Figure 162). Each of these holes measures 3/4 inches in diameter. If completed, the baffle plate would have followed the shape of the fire door, but would have been of reduced height and width (Figure 163). This allowed the door to be closed flush against the door frame, while permitting the baffle plate to rest just above the dead plate. A similar example of a baffle plate can be seen on the steamboat *Moyie* (Figure 164). The spacing of the holes and the thickness of the cast iron is almost identical to the fragment recovered from *Westfield*.

When utilizing the fire doors, the fire men moved about considerably. To prevent slipping, the floor of the boiler room was covered with cast iron diamond patterned "scuff" plates. A large quantify of this artifact type was recovered near both the firebox and the former engineering compartment. The best preserved example consists of a relatively large and mostly intact plate (Figure 165). The plate measures 29 x 24 inches and 0.5 inches thick and has countersunk holes in the corners for some form of fastener. A smaller example of this plate has a stepped section on the edge that once formed the seam between two plates. The other plate would have sat over this stepped edge, interlocking the two plates together (Figure 166). Another type of diamond panel was utilized above the boiler room, in the upper machinery compartment (Figure 167). This diamond panel was open like a grate, so the heat from below could rise up and evacuate the lower hull. A similar example can be seen in the burned out hulk of the ferryboat *Plainfield* (Figure 168).

The chimney flue was situated above the fire doors and the inner furnaces. This location marked the termination point for the fire tubes. While no remnants of the fire tubes were found, a single access door for maintaining and cleaning the tubes was recovered (Artifact 109-127). Known as a flue door, this artifact was considerably damaged and twisted (Figure 169). The artifact originally measured approximately 22 inches wide by 16 inches tall. Based on a series of fastener holes, conservators believe this artifact had a similar construction as the fire doors. The surviving portion

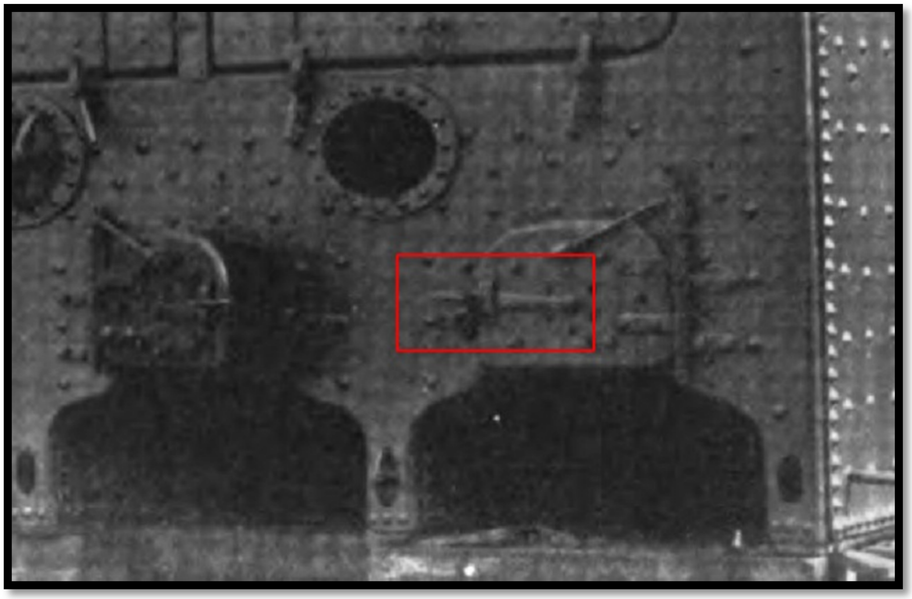

FIGURE 160. FIRE DOOR HAND LEVER ON *PERRY* BOILER (UNIDENTIFIED 1902:523)

FIGURE 161. FIRE DOOR LEVER AND PIN (ARTIFACT 125-006; SCALE CM)

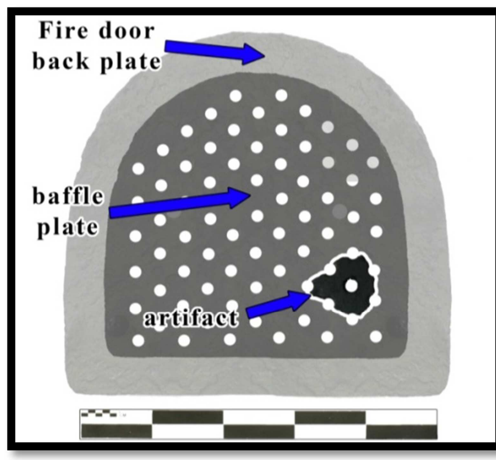

FIGURE 163. *WESTFIELD*'S RECONSTRUCTED BAFFLE PLATE

FIGURE 162. CAST IRON FRAGMENT OF BAFFLE PLATE (ARTIFACT 119-197)

FIGURE 164. BAFFLE PLATE FROM STEAMBOAT *MOYIE* (IMAGE COURTESY OF SS *MOYIE* NATIONAL HISTORIC SITE OF CANADA)

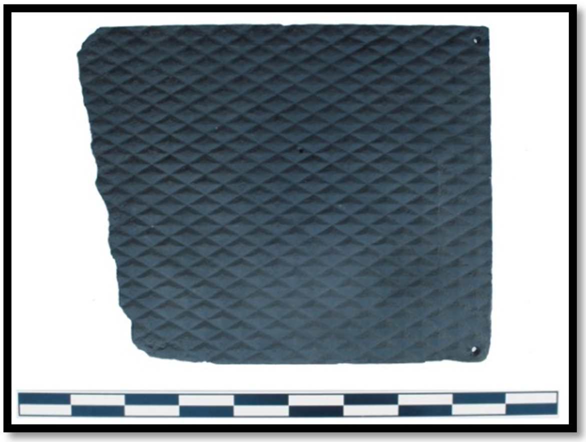

FIGURE 165. DIAMOND PATTERNED SCUFF PLATE FROM BOILER ROOM (ARTIFACT 133-004; SCALE DM)

FIGURE 166. DIAMOND PATTERNED SCUFF PLATE WITH JOINING SEAM (ARTIFACT 132-001.73)

FIGURE 167. OPEN DIAMOND PATTERNED SCUFF PLATE FROM MAIN DECK (ARTIFACTS 120-033 AND 120-034)

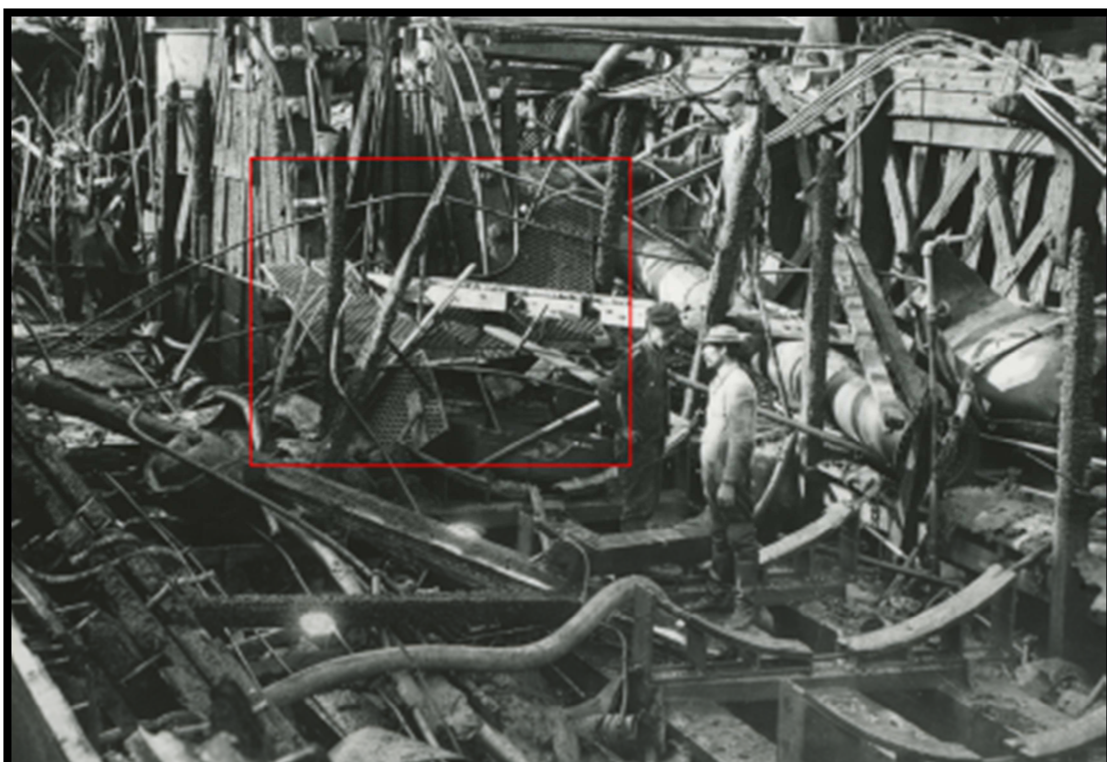

FIGURE 168. OPEN DIAMOND PATTERNED SCUFF PLATES FROM HULK OF FERRYBOAT *PLAINFIELD* (IMAGE COURTESY OF MYSTIC SEAPORT)

FIGURE 169. FLUE DOOR FROM *WESTFIELD* BOILER (SCALE CM/DM)

FIGURE 170. PLATE FROM UPPER FIRE BOX COVER (ARTIFACT 124-032; SCALE DM)

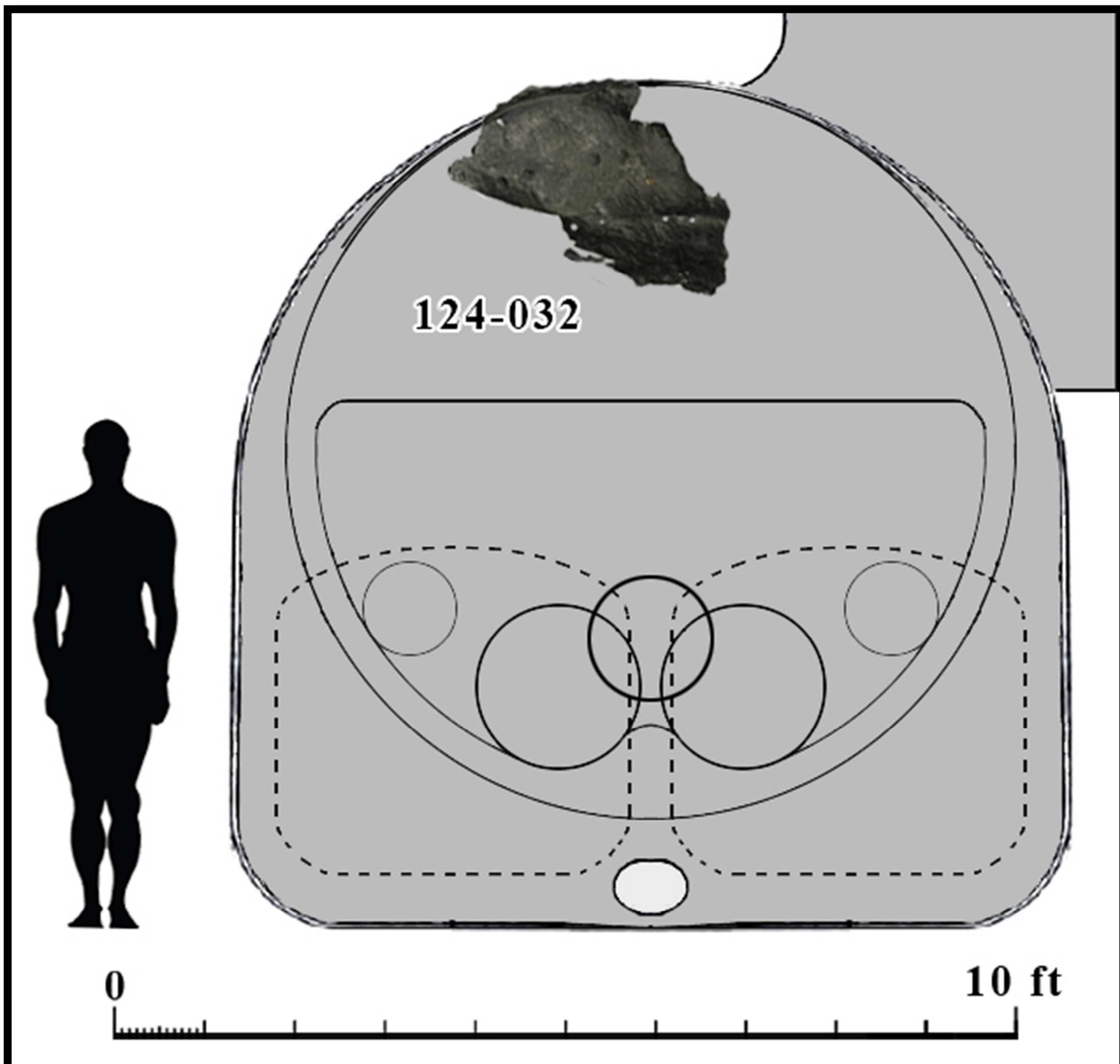

FIGURE 171. PLATE FROM UPPER FIRE BOX COVER IN CONTEXT

of the door represents the outer cover plate. The rear plate and staybolts are missing. Other holes on the plate may indicate where hinges were once placed. Unfortunately, not enough of the plate survives to make any definitive conclusions.

The top of the firebox portion of the boiler was originally rounded. In this location, water gauges and cocks were placed just above head level to prevent damage from working firemen, but also to give a clear vantage point to any workers in the room. These gauges were essential in preventing the water level in the boiler from becoming too low. A large recovered plate is believed to have come from this location (figures 170 and 171). The plate contains a rounded top and many internal staying devices. More importantly, a thread brass pipe was screwed through the object to the internal chamber. The end of the pipe, on the outside of the boiler is broken. The pipe likely supported some form of water gauge.

Large flues carried the heated gases, ash, and smoke from the firebox into the boiler barrel. Unlike the firebox, the barrel no longer exists. Yet numerous fragments survived that help explain the original design. Most of the riveted plate recovered from the wreck site is believed to have originated from the boiler barrel, because while most of the plates are deformed they still retain curvature. Two of the best examples can be found in Artifacts 110-005 and 119-001 (figures 172 and 173). One of the most notable features of these artifacts is the absence of internal staying devices. This is not to say that these devices did not exist in the barrel, but only that they were not as necessary and therefore more sparingly used. Unlike the firebox which required heavy staying on the numerous flat surfaces, the round shape of the barrel expanded and contracted with more ease.

The barrel originally would have sat higher than the firebox and required large mounts to hold the rounded structure in place. During the mapping of the wreck site, eight of these boiler mounts were identified. Four were successfully recovered (Artifacts 105-005, 119-018, 119-024, and 120-003), and two were conserved (Artifacts 119-026 and 120-003). The mounts are made of heavy cast iron and consist of a rectangular lower base and a curved upper portion that matched the shape of the outer barrel (Figure 124). Between the mounts' upper curvature and lower base, cross bars were molded into the mounts at an angle. The angle ensured that the weight of the barrel passed down through the mounts diagonally to prevent vertical crushing. To ensure that the mounts would not push away from each other or from the barrel, a large bolt originally ran through each mount lengthwise and connected with the counterpart mount on the other side of the barrel. An example of this arrangement can be seen on the burned out hulk of the ferryboat *Plainfield*. The boiler has been removed and the mounts with their connecting rods are visible (figures 174 and 175). As in the image, *Westfield*'s mounts would have been placed over large wooden beams that ran perpendicularly across the center keelson and side sister keelsons. Wood from these beams remained concreted to the mounts following recovery. These fragments were removed and conserved.

FIGURE 172. LARGE SECTION OF PLATING FROM OUTER BOILER BARREL (ARTIFACT 110-005; SCALE CM/DM)

FIGURE 173. SMALL SECTION OF PLATING FROM OUTER BOILER BARREL (ARTIFACT 119-001; SCALE CM/DM)

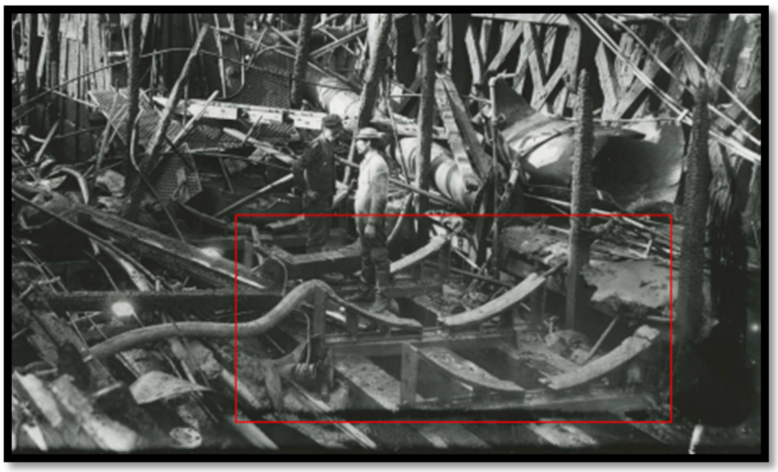

FIGURE 174. BOILER MOUNTS FROM BURNED OUT HULK OF FERRYBOAT *PLAINFIELD* (IMAGE COURTESY OF MYSTIC SEAPORT)

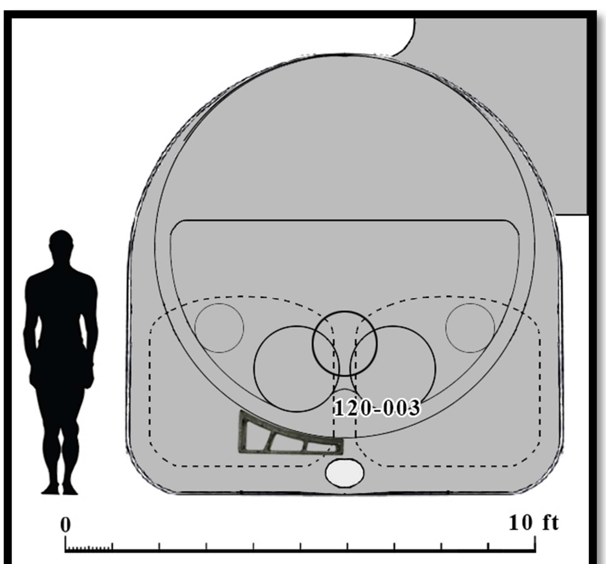

FIGURE 175. ONE OF *WESTFIELD*'S BOILER MOUNTS IN CONTEXT

Curvature on the boiler mounts indicates that the rear boiler barrel contained an 8 ft diameter. This information helps determine how the barrel connected to the firebox. On some boilers, the curved top of the firebox section extended all the way to the back of the barrel. This meant that the barrel shared the same diameter or width as the firebox. Sometimes, top of the firebox and the barrel contained two different diameters that joined together on a common edge as eccentric circles. Based on the measurements from *Westfield*'s artifacts, this latter scenario seems to be the case. Three other artifacts offer evidence that support this idea (Artifacts 119-003, 121-014, and 121-017). These artifacts consist of heavily reinforced riveted plates that once attached the barrel to the back of the firebox. Although now relatively flattened, Artifact 121-017 originally formed the highest connection point between the firebox and the barrel (Figure 176). At this height, the two different diameters are less evident. On the artifact, three distinct levels of plating can be seen. As the plates extend towards the firebox, each plate level steps upwards, and is securely riveted together. The lowest underlying plate represents the boiler barrel. The middle plate with two lines of rivets, served as the connecting strap. The highest plate formed the edge of the firebox. Artifact 121-014 is also flattened, but still retains a purposefully folded plate that shows where the two circles began to deviate away from each other due to their different sized diameters (Figure 177). On Artifact 119-003, this deviation becomes fully recognizable as the folded plate clearly arches upward towards the firebox and away from the lower barrel (Figure 178). In figure 179, all three artifacts can be seen in their original context.

Like the previous artifacts, Artifact 133-011 served as a connection point between the boiler barrel and firebox; however, this object originated from the bottom of the boiler (Figure 180). For this reason, the artifact does not display the eccentric circles. Instead the artifact contains a well preserved, albeit slightly crushed portion of the barrel curve, and a section from the rectangular base of the firebox. The artifact also demonstrates that, in its original context, an additional double-riveted strap branched off from the barrel, before running down the back of firebox and folding underneath.

A second artifact came from the same vicinity. Artifact 133-007 was placed slightly higher up on the side of the firebox, yet still below the boiler barrel. The most unique feature consisted of an attached brass pipe flange (Figure 181). Feed pipes leading into the boiler would have been used to refuel the water level. This pipe likely led back to the valve system located beneath the hot well reservoir on the walking beam engine. During conservation, the question arose as to whether this artifact could have come from the front or sides of the boiler, or possibly higher up on the back of the firebox. Several staybolt holes in the metal eliminated any chance that the artifact came from the boiler's front. Staybolts on the front of the boiler would have been on either side of the fire doors. Based on the width of each furnace, this artifact would not have been able to fit without interfering with fire doors. The second evidence comes from the joining of the outer plate with the line of rivets that run up the artifact's side. Based on other recovered artifacts, plates from the front

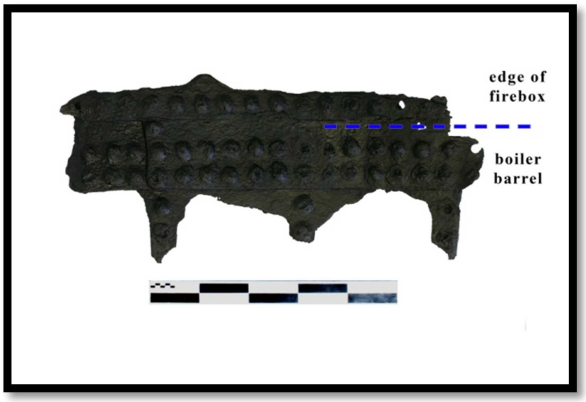

FIGURE 176. UPPER BOILER BARREL CONNECTION PLATES (ARTIFACT 121-017; SCALE CM/DM)

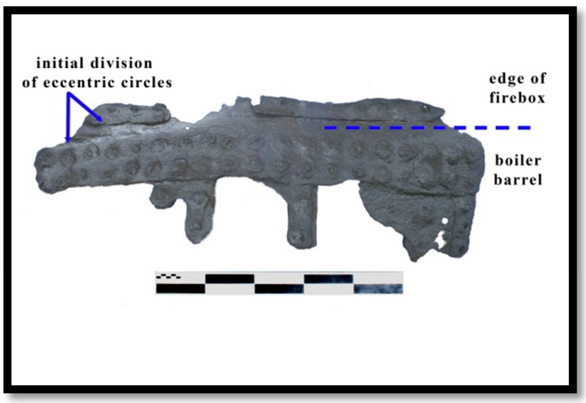

FIGURE 177. UPPER TO MIDDLE BOILER BARREL CONNECTION PLATES (ARTIFACT 121-014; SCALE CM/DM)

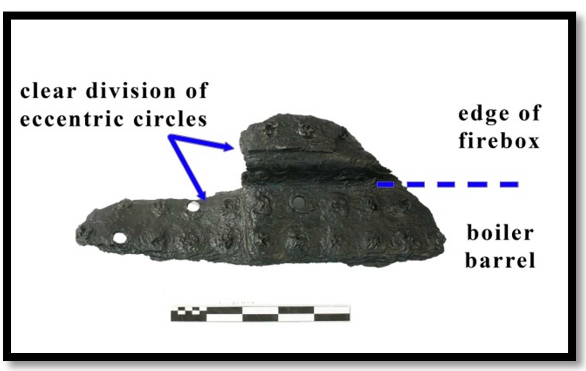

FIGURE 178. MIDDLE BOILER BARREL CONNECTION PLATES (ARTIFACT 119-003; SCALE CM/DM)

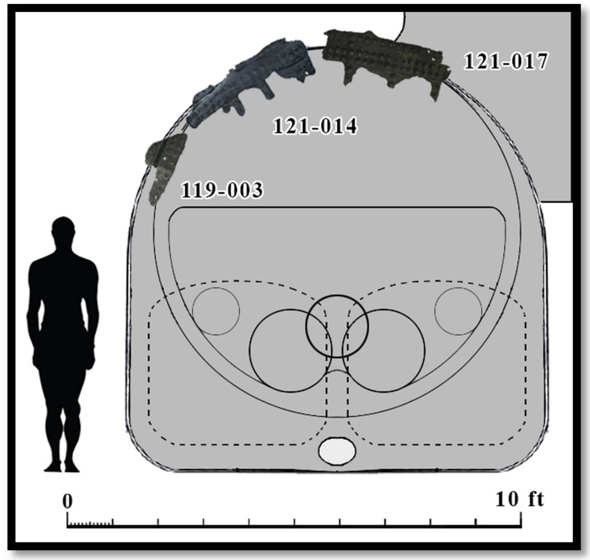

FIGURE 179. BOILER BARREL CONNECTION PLATES IN CONTEXT

FIGURE 180. LOWER BOILER BARREL CONNECT PLATES (ARTIFACT 133-011; SCALE CM/DM)

FIGURE 181. REAR FIREBOX FEED WATER PIPE (ARTIFACT 133-007; SCALE CM/DM)

and rear of the firebox, as well as those from the back of the boiler barrel, always tucked underneath the side plates. Why this was done is not clear, however based on historic photography this riveting pattern seems to have been the norm. The last suggestion of the object being higher is also not possible. Anything higher would have interfered with the boiler barrel. This suggestion arose due to the curvature on the strap of rivets.

Close examination reveals that the seam of Artifact 133-007 contains original curvature. This curvature marks the transition point where one of the water legs begins to curve under the boiler. Figure 182, displays Artifacts 133-011 and 133-007 in their original context. A final comment on Artifact 133-007 relates to a bar-like strap that is mounted near the flange with three bolts and underlying washers. One of the recovered man holes, still retained a portion of boiler plating (Artifact 119-019). Mounted to that plate, was a similar bar-like strap (Figure 143). A considerable amount of this strap material was recovered from the wreck site. These straps were intended to hold the boiler in place. They would have secured both boilers together and to the inner hull of the ship. An identical example can be seen on the steamboat *Ticonderoga* (Figure 183). The only difference is that on *Ticonderoga*, the strap material joined to the boilers horizontally. Based on Artifact 133-007, *Westfield* used this strap in a diagonal fashion. The straps would have crossed between the two boilers, likely at several locations, creating an "X". Artifact 118-002 may be an example of these crossed securing straps from between the boilers (Figure 184). The artifact is constructed of the same thickness and width. Several broken bolts through the metal show how the artifact was once secured.

A massive section of the lower flues survived from inside the boiler barrel. Artifact 122-001 consists of two flues and the lower base section of the rear combustion chamber (Figure 185). Combined, the artifact measures 10.1 x 6.0 x 3.0 ft. The flues were built of wrought iron sheets, folded over, and riveted into tubular sections. Each section was then riveted to the next, to create the overall flue. Inside, each flue has a diameter of 1¾ ft. Both flues join onto a plate that has been carefully formed outwards and then tucked inside the base of the combustion chamber. The unique folds on this plate make the transition of the metal appear almost organic. This same fluid design stands out on Artifact 133-014, although on a much smaller scale (Figure 186). This artifact appears to have served the same function and likely came from slightly higher up on the combustion chamber (Figure 187). While considerably distorted, enough of the original curve remains to determine that the artifact once held a flue with an internal diameter somewhere between 10-14 inches.

One smaller separated flue was recovered (Figure 188). Artifact 121-010 consists of two pipe segments with an internal diameter of approximately 1 ft. Although smaller, the construction is identical to the larger flues. These artifacts suggest that in addition to the two main flues that left the firebox and joined the combustion chamber, additional smaller flues followed that same path.

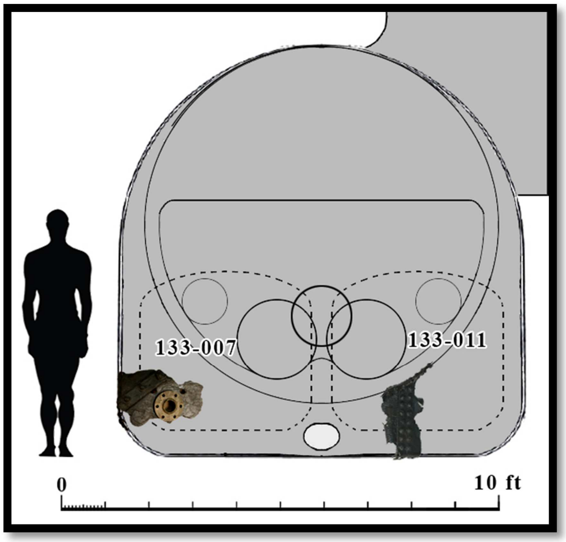

FIGURE 182. ARTIFACTS 133-007 AND 133-011 (FIGURES 180 AND 181) IN CONTEXT

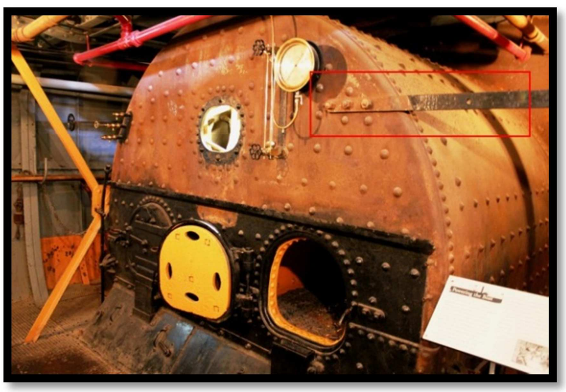

FIGURE 183. WROUGHT IRON BOILER SECURING STRAPS ON STEAMBOAT *TICONDEROGA* (PHOTOGRAPHER UNKNOWN)

FIGURE 184. WROUGHT IRON BOILER SECURING STRAPS FROM *WESTFIELD* (ARTIFACT 118-002; SCALE CM/DM)

FIGURE 185. *WESTFIELD*'S BOILER FLUES (ARTIFACT 122-001; SCALE INCHES)

FIGURE 186. PLATING DESIGNED TO HOLD SMALLER ROUND FLUE (ARTIFACT 133-014; SCALE CM/DM)

FIGURE 187. BOILER FLUES (ARTIFACT 133-014) IN CONTEXT

This is to be expected since most boilers of *Westfield*'s size (based on the firebox) utilized smaller upper side flues to maximize the transfer of heat into the water. Several examples of this layout can be found in the U.S. steamers *Commodore Barney*, *Ella*, *Bibb*, and *General Putnam* (Isherwood 1865: plates XIV, XV, XVII, and XXI). Each of these vessels contained return flue boilers of a similar design to what *Westfield* is believed to have used (Figure 189).

FIGURE 188. SMALLER UPPER SIDE FLUE ON *WESTFIELD* (ARTIFACT 121-010; SCALE DM)

The surviving portion of *Westfield*'s combustion chamber measured 2.2-x-6.0-x-3.0-ft (Figure 190). The base of the chamber was secured to the outer boiler barrel with several types of fasteners. Most of the underside, but not the direct bottom, used threaded staybolts. Many of the bolts were also found on the back wall. All of these bolts are heavily corroded, with only a few of them displaying their original threads. The more preserved examples show that after placement, the bolts were hammered over on both sides into conical rivets. The spacing appears similar to staybolts on the firebox, but this cannot be confirmed. The plating where most staybolts were positioned has corroded away. Of the staybolts that remain, they are too far from each other to determine a definitive spacing pattern. Several examples of these bolts were found separately from the combustion chamber and are in considerably better condition. These bolts were conserved as representative examples (Figure 191). At the very bottom of the chamber, the remnants of two double-ended crow's feet indicate, that like the firebox, the iron workers did not trust placing a heavy load onto staybolts. Staybolts were utilized inside compartments, but whenever a direct load required support, double-ended crow's feet were the fastener of choice.

One section from higher up on the combustion chamber was recovered separately (Figure 192). Artifact 132-001.76 consists of plate fragments from both the outer water jacket and the inner combustion chamber. Heavy staybolts secured these plates together. These staybolts are considerably larger and more robust than those found on the firebox. After the bolt passed through the plates and the central sleeve, a large threaded square nut was screwed down over a washer. This was common design found on other boilers (Figure 193). Although unclear, the heavy-duty

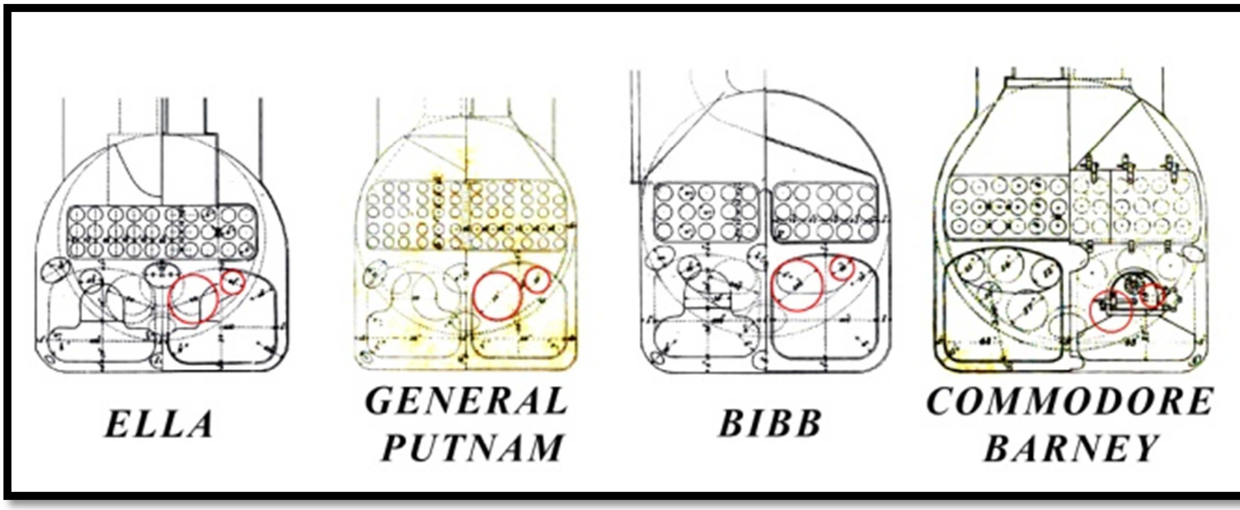

FIGURE 189. RETURN FLUE BOILERS WITH SMALLER UPPER SIDE FLUES

FIGURE 190. REMAINS OF LOWER COMBUSTION CHAMBER (ARTIFACT IS UPSIDE DOWN)

FIGURE 191. THREADED STAYBOLT WITH HAMMERED ENDS (ARTIFACT 132-182)

FIGURE 192. UPPER FRAGMENT OF COMBUSTION CHAMBER (ARTIFACT 132-001.76; SCALE CM)

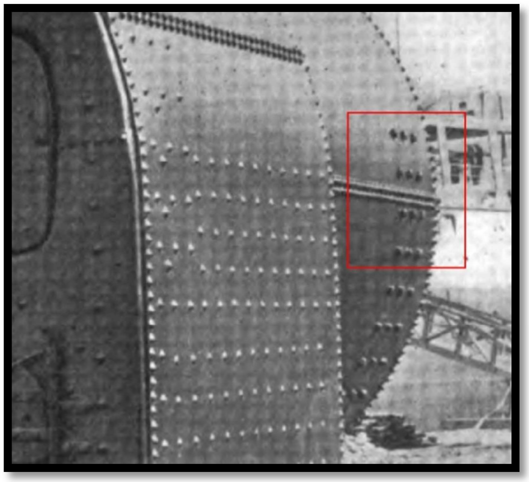

FIGURE 193. LARGER STAYBOLTS ON *PERRY*'S COMBUSTION CHAMBER

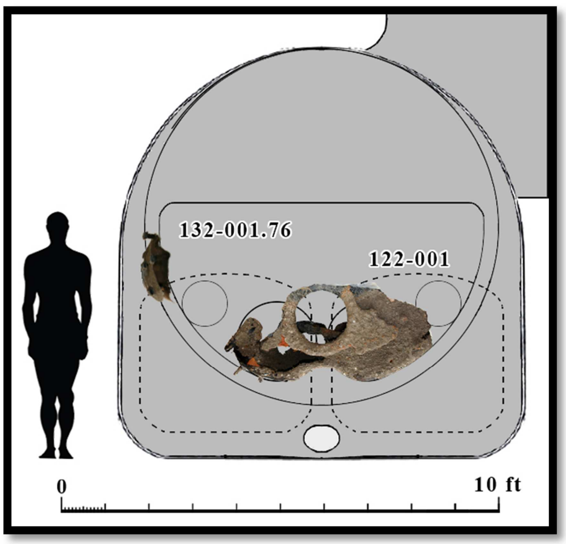

FIGURE 194. COMBUSTION CHAMBER BASE AND UPPER FRAGMENT IN CONTEXT (ARTIFACTS 122-001 AND 132-001.76)

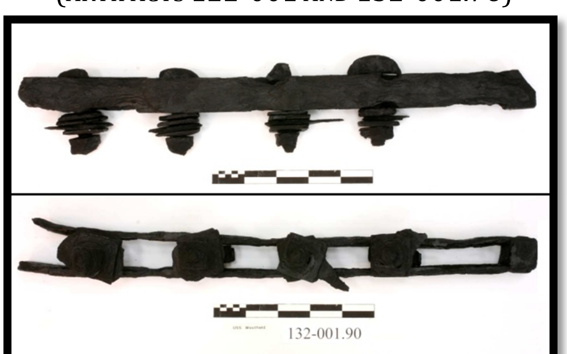

FIGURE 195. GIRDER STAY FROM TOP OF COMBUSTION CHAMBER (ARTIFACT 132-001.90; SCALE CM)

FIGURE 196. REAR ACCESS HATCH TO COMBUSTION CHAMBER (SCALE INCHES)

FIGURE 197. DOOR FROM HATCH ON REAR COMBUSTION CHAMBER (ARTIFACT 120-009; SCALE DM)

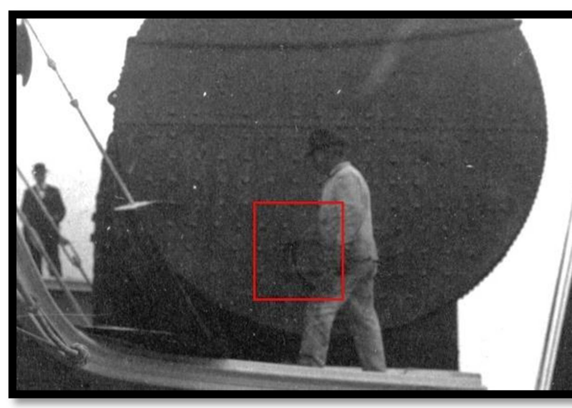

FIGURE 198. COMBUSTION CHAMBER DOOR ON THE STEAMER *MARY POWELL* (IMAGE COURTESY OF THE STEAMSHIP HISTORICAL SOCIETY OF AMERICA)

nature of these bolts may have something to do with the round shape of the boiler barrel. The interior combustion chamber occupied a large area at the rear of the barrel. As the barrel expanded and contracted, this type of reinforcement may have been necessary to ensure the chamber did not become dislodged. Figure 194 displays the remnants of the rear combustion chamber and artifact 132-001.76 in context.

The top of the combustion chamber would have been flat as on most boilers. To ensure that the top of the chamber did not warp, heavy staying devices were required. These devices were known as girder stays. They were typically used when it was "not convenient to stay a flat surface to the opposite shell of the boiler" (Peabody and Miller 1894:108). These devices were commonly used on return flue scotch boilers to support the roof of combustion chambers (International Correspondence Schools 1897:330). One such device was recovered from *Westfield* (Artifact 132-001.90). The artifact appears very similar to the girder stays found in scotch boilers, although somewhat more primitive and possibly an earlier version (Figure 195). One end of the girder stay contains a slightly angled clamp that fit over another object. The other end has broken off, but still retains portions of the clamp, showing that not much of original size has been compromised. Passing through the girder are four threaded bolts containing hooks. The hooks lay over the girder, and the bolts passed through the center, and then into the combustion chamber. Fragments from the top plate of the combustion chamber are still threaded onto the bolt. Underneath, on the end of each bolt, square nuts and washers held the entire assembly together. The surviving base of the combustion chamber measures 2.2 inches wide. Not accounting for the end clamps, the central portion of the girder stay measures approximately 29 inches. The closeness of these two measurements suggests the girder stay came from this location of the boiler.

In order to clean the interior of the combustion chamber, a large access port was situated on the lower rear wall (Figure 196). This circular opening survived intact, and the diameter measures 16.0 inches. A single circular door (Artifact 120-009) was recovered and is believed to have originated from this location (Figure 197). The door has a diameter of 22 inches. The construction of the door matches that found on the fire doors. A front and rear plate are joined together with four small staybolts to maintain an even space between them. A single hinge runs across the door's outside plate diameter, before breaking off just past the edge. Like the fire doors, this round door closed against the outside of the boiler, rather than being seated in an internal frame. A similar example of this door can be seen in a historic photo of the steamer *Mary Powell* (Figure 198).

Four remaining artifacts fall into a miscellaneous category; however, all are believed to have been associated with the boiler room. Artifact 132-011 consists of a single cast iron wheel (Figure 199). The wheel contains four reinforced spokes that radiate out from a central shaft. Two small holes are placed within this shaft, along the interior walls. These holes were likely used for a key that held an axle in place. This wheel is believed to have come from a small engine. *Westfield*'s boiler system

Figure 199. Cast iron wheel from donkey engine (artifact 132-011; scale cm/dm)

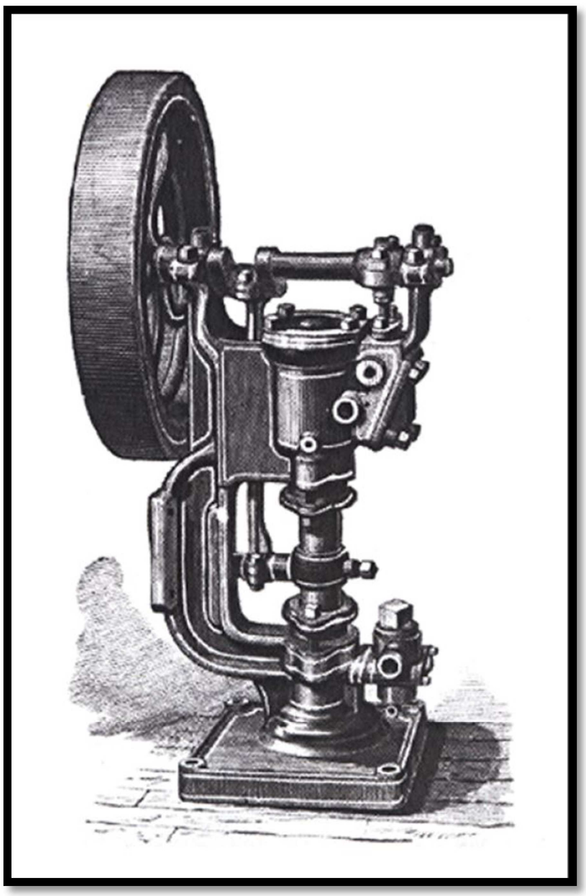

Figure 200. Example of small auxiliary donkey engine (Whitham 1893:474)

Figure 201. Coal stoker handle (artifact 133-132)

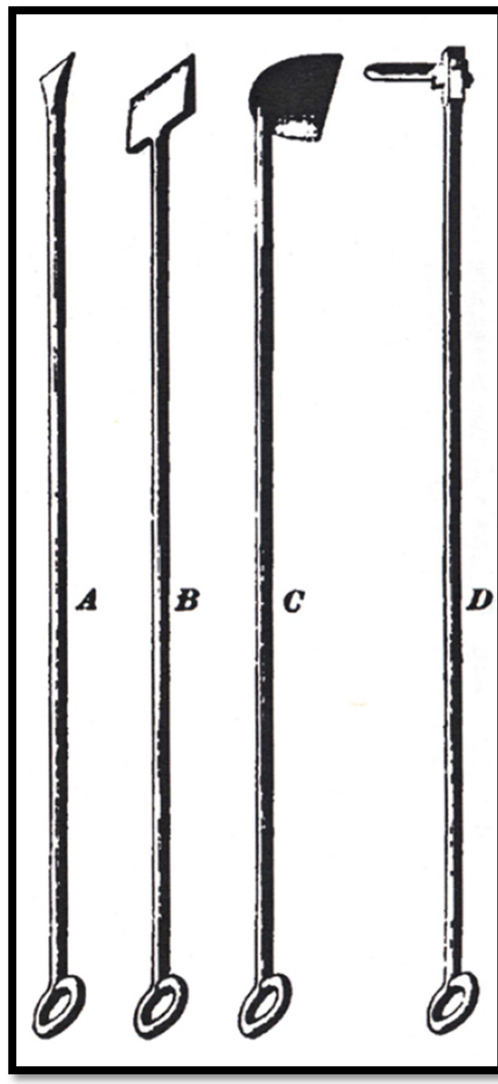

Figure 202. Examples of coal stokers (International Correspondence Schools 1897:454)

required a constant source of water. To accommodate that need, *Westfield*'s walking beam engine powered not only the paddle wheels but also pumped water continuously to the ship's boilers. When *Westfield* was not in motion, the boilers instead relied on a smaller, independently-run donkey engine. These types of auxiliary engines generally contained a single-acting cylinder and utilized a belt and wheel system that pumped water into the boilers as well as other crucial areas of the ship (Figure 200).

A second artifact (133-132) was likely a stoker handle used to tend the fires within the furnaces (Figure 201). Commonly, four types of stoker tools were used (Figure 202). The "slice" bar broke up the fire's thick surface crust when using bituminous coal. Anthracite coal burned considerably more efficiently, and did not tend to clump together. Generally, only the cinders needed occasional breaking. The similar "T" bar tool achieved this. A "hoe" bar was used to level the fire and clean out the lower ash pits. Finally, the "poker" bar reached in between the gratings and allowed the fireman to clean any ash or broken bit of coal out from within the slots.

The two final artifacts (120-308 and 128-016) are both relatively identical, consisting of a sheave and pin (Figure 203). Individually, each sheave is made up of a cast iron wheel that utilizes internal brass bearings. Within the bearings both artifacts had a remnant of a wrought iron pin. The edges of the wheel are recessed to carry a cable or chain. Normally, a block or sheave during this period was made of wood. These artifacts seem like they were intended to carry an extremely heavy load. Although the use of these artifacts has not been conclusively identified, there is a possibility that they were used to haul heavy loads of coal. One theory suggests that they may have been positioned on each side of the boiler to allow for the quick transport and refilling of the coal bunkers.

FIGURE 203. CAST IRON SHEAVES WITH BRASS BEARINGS (ARTIFACTS 120-308 AND 128-016)

Ordnance

Westfield was not only valuable as a gunboat of the U.S. Navy, but also for the collective worth of its armament and munitions. Keeping this firepower out of Confederate hands likely compelled the decision to destroy the flagship. The shortage of capable artillery during the Civil War was dire, as evidenced by the desperate measures taken to secure arms, including fashioning cannon from *Westfield*'s paddlewheel shaft. Though much, if not most, of *Westfield*'s armament and ammunition was salvaged immediately following her destruction, an assortment of shot, shells, small arms, and one cannon were among the artifacts recovered during fieldwork.

Artillery

The Dahlgren cannon was one of the world's most powerful weapons when it was developed in the 1850s and it would later become the principal gun of the U.S. Navy during the Civil War (Schneller 1986:v). The heavy, smoothbore, cast-iron guns were designed by Admiral John A. Dahlgren as acting head of the U.S. Navy Ordnance Department. To compensate for the inherent weakness at the breech of traditional cast-iron guns, Dahlgren reinforced this area by increasing the thickness of the metal. This design improved the gun's capacity to withstand the firing pressure and resulted in a revolutionary new shape characterized by smooth lines and a bottle-shaped profile. The guns were advantageous in that they could fire both shells and solid shot and were thus capable of penetrating the hulls of wooden vessels and ironclads (Gabel 2001:29; Ripley 1970:90; Schneller 1986:29). This weapon was Dahlgren's most successful design, being widely used and relied upon by the U.S. Navy, and more efficient than the naval guns formerly employed by the Union fleet (Gabel 2001:29; *Harper's Weekly* 1861; Manucy 1949:13). Between 1855 and 1864, 1185 naval 9-inch Dahlgren shell guns were produced by five foundries: Cyrus Alger and Company (South Boston), Fort Pitt Foundry (Pittsburgh), Seyfert, McManus, and Company (Reading, Pennsylvania), West Point (Cold Spring, New York), and Tredegar and Bellona (Virginia) (Kinard 2007:205; according to Olmstead et al. [1997], 1201 were manufactured).

Westfield's armament included one pivot-mounted 9-inch Dahlgren in 1862 when it was converted to a U.S. Naval vessel, but shortly before its destruction, it acquired a second 9-inch Dahlgren cannon from *Clifton* to replace its Parrott rifle, which had exploded when shelling Lavaca. Two examples of Dahlgren 9-inch cannon are illustrated below (figures 204 and 205) from the Mathew Brady photographic collection at the National Archives. These guns measured 10 ft 11 in long and weighed 4.5 tons. They could fire a 74-pound shot two thirds of a mile. The Dahlgren in Figure 204 is shown mounted as a broadside gun on a Marsilly carriage as was believed the case for the gun recovered from *Westfield*. The Dahlgren shown in Figure 205 is mounted on a pivot carriage, as was the Dahlgren originally supplied to *Westfield* during its conversion to military use.

It is apparent from the Confederate Prize Records that one Dahlgren was overlooked by the Confederate salvers, as only six of its seven guns were recovered. These cannon were reported to have been "embedded in the sand under the water." Salvers also recovered a Dahlgren pivot carriage (Appendix A-2, Letter 7). The remaining 9-inch Dahlgren (Artifact no. 123-1) was discovered in 2005. It was found in an overturned position, similar to one of the guns salvaged in

FIGURE 204: HISTORIC IMAGE OF A DAHLGREN 9-INCH CANNON. COURTESY OF THE NATIONAL ARCHIVES, FROM THE MATHEW BRADY CIVIL WAR PHOTOS COLLECTION.

FIGURE 205. PIVOT-MOUNTED 9-IN DAHLGREN, PROBABLY ON USS *MIAMI*, 1864 (IMAGE COURTESY OF THE NATIONAL ARCHIVES, FROM THE MATHEW BRADY CIVIL WAR PHOTOS COLLECTION, # 51).

FIGURE 206. *WESTFIELD* DECK SOCKET FOR PIVOT CARRIAGE (ARTIFACT 122-046; SCALE CM/DM)

FIGURE 207. *WESTFIELD* DECK SOCKET FOR PIVOT CARRIAGE (ARTIFACT 122-046)

FIGURE 208. SOCKET FOR PIVOT CARRIAGE IN DECK OF UNIDENTIFIED GUNBOAT.

FIGURE 209. *WESTFIELD* DAHLGREN SERIAL NUMBER (ARTIFACT 123-001)

1863 (*Houston Tri-Weekly Telegraph* 1863a). A heavy brass deck socket for a pivot carriage (Artifact 122-046; figures 206 and 207) was recovered near the rear cabin bulkhead. This was presumably associated with the pivot Dahlgren mounted at the stern. An example of how the pivot socket would have been incorporated into the main deck is shown in the right foreground of Figure 208. It is unclear how such a heavy artifact, its shaft originally embedded in the main deck, moved forwards the length of the aft deck before sinking to the seafloor. One possible scenario is that a section of deck containing the socket detached under its weight as the vessel burned but retained sufficient buoyancy to float forward until coming to rest near the cabin bulkhead.

The *Westfield* Dahlgren's government serial number, No. 144, is stamped on top of the gun just forward of the gun sight position (Figure 209). The gun was cast at the Cyrus Alger and Company foundry in south Boston in 1857 (Olmstead, et al. 1997:243). The serial number might ultimately be used to establish the origin of the recovered Dahlgren, as originally belonging either to *Westfield* or borrowed from *Clifton.* The authors suspect, based on its location within the debris field, that the recovered Dahlgren was positioned in the broadside gun port immediately aft of the cabin on the starboard side when the ship was destroyed. Since *Westfield's* original Dahlgren was pivot-mounted at the stern, this position implies that the recovered gun was mounted on a Marsilly carriage and was the gun borrowed from USS *Clifton,* although that determination has yet to be confirmed by research. The conserved Dahlgren is illustrated in Figure 210 as it now appears on a reconstructed Marsilly carriage.

FIGURE 210. *WESTFIELD* 9-INCH DAHLGREN ON RECONSTRUCTED MARSILLY CARRIAGE (ARTIFACT NO. 123-001)

The left trunnion is stamped “P” for proof and “WRT” (Figure 211), indicating that the gun was inspected at the foundry by William R. Taylor in his first year working at the Alger foundry (Olmstead, et al. 1997: 170). The right trunnion is marked “IX IN” for 9-inch Dahlgren. The Alger foundry casting number “1082” is stamped on the rimbase of the right trunnion (Figure 211) and on the top of the cascabel as stipulated by The Bureau of Ordnance (Unidentified 1881:331). Just forward and to the side of the left firing mechanism is stamped the cannon’s weight, “9155” pounds. The foundry’s initials, located on the base line just to the side of the right ignition base, have eroded away.

FIGURE 211. IDENTIFYING STAMPS ON *WESTFIELD*’S 9-INCH DAHLGREN

Several artifacts recovered from the site in the vicinity of the cannon have been identified as parts of a gun carriage or associated tackle. Details from the Brady Collection photograph shown in Figure 204 are enlarged in Figure 212 to illustrate the function of various artifacts recovered from the site including: a rear gun sight (figures 213 and 214; compare Figure 212-A); a firing hammer and hammer cord (figures 215, 216 and 217; compare Figure 212-B); a fragment of an elevation screw (Figure 218; compare Figure 212-C); and a cascabel block, attached when recovered, used to secure the breach rope (figures 219 and 220; compare Figure 212-D).

The Dahlgren’s rear gun sight (figures 213 and 214) was recovered from sediment directly beneath the cannon. Both pieces are stamped with the Dahlgren’s government serial number, 144. The bent firing hammer (figures 215 and 216) was attached to the Dahlgren when it was recovered and, likewise, is stamped with serial number 144. A coil of well-preserved cord, believed to be the Dahlgren’s hammer cord (Figure 217), was recovered from inside the cannon’s muzzle. A more

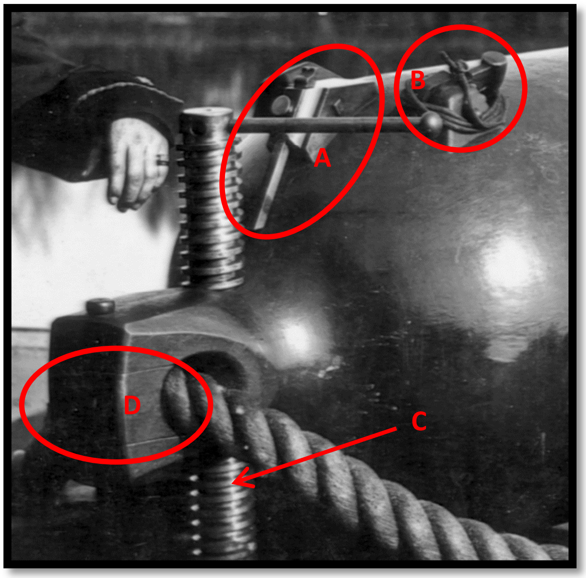

FIGURE 212: DAHLGREN DETAILS: A-FRONT SIGHT, B-HAMMER AND CORD, C-ELEVATION SCREW, D-CASCABEL BLOCK (IMAGE COURTESY OF THE NATIONAL ARCHIVES, FROM THE MATHEW BRADY CIVIL WAR PHOTOS COLLECTION).

FIGURE 213: DAHLGREN REAR GUN SIGHT (SIDE) (ARTIFACT 123-34; SCALE CM)

FIGURE 214: DAHLGREN REAR GUN SIGHT (TOP) (ARTIFACT 123-34; SCALE CM)

FIGURE 215: DAHLGREN FIRING HAMMER (SIDE) (ARTIFACT 123-001.1)

FIGURE 216: DAHLGREN HAMMER (BOTTOM) (ARTIFACT 123-001.1)

FIGURE 217: DAHLGREN HAMMER CORD
(ARTIFACT 123-001.5)

FIGURE 218: DAHLGREN ELEVATION SCREW
(ARTIFACT 124-049; SCALE CM)

FIGURE 219: DAHLGREN CASCABEL BLOCK (SIDE)
(ARTIFACT 122-002; SCALE CM)

FIGURE 220: DAHLGREN CASCABEL BLOCK (TOP)
(ARTIFACT 122-002; SCALE CM)

FIGURE 221. REAR GUN SIGHT COVER
(ARTIFACT 104-17)

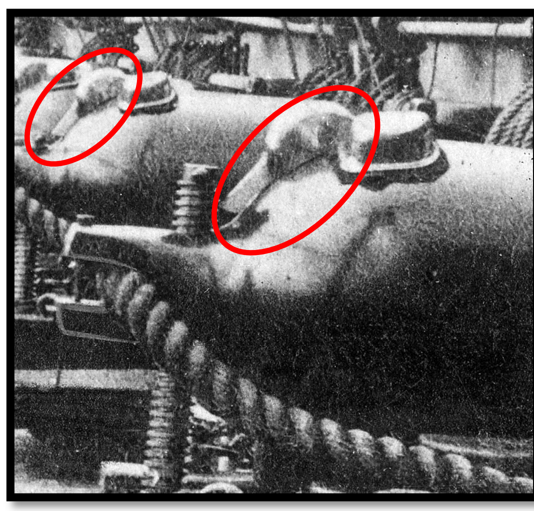

FIGURE 222. DAHLGREN REAR GUN SIGHT
COVERS ON USS *HARTFORD*
(PHOTO COURTESY OF THE NHHC)

complete portion of the elevation screw (not shown) was attached to the cannon when it was recovered.

A rear gun sight cover (Figure 221) was recovered about 30 ft aft of the Dahlgren. It is 12 x 2⅝ x 3 inches and marked "PF 8 OF 56." Its style matches site covers used on Dahlgren cannons (Figure 222, for example); however, it does not quite fit over the recovered gun sight. This artifact might be associated with the other Dahlgren, which was recovered by Confederate salvers in 1863.

Details of a historic Marsilly gun carriage (Figure 223) show three examples of gun carriage tackle resembling artifacts recovered from the site including a cap square (Figure 224; compare Figure 223-A); a breach rope guide (Figure 225; reproduction based on radiographic image in Figure 63; compare Figure 223-B) and an eyebolt (Figure 226; Figure 223-C). The cap square is clearly from a gun carriage, though not necessarily a Marsilly type. It was found about 40 ft aft of the cannon and within about 17 ft of the gun sight cover. It is possible that both the cap square and the sight cover might have been associated with the Dahlgren pivot cannon mounted on the stern.

A variety of ammunition and components of the same was recovered from the site including spherical cannon shells, wooden sabots, fuses, solid iron shot (separately and in canisters), and fragments of exploded shells. *Westfield* received a shipment of ammunition that was delivered with the 32-pounder on December 28, 1862, only 3 days prior to its destruction (Cotham 2006:127). Confederate divers salvaged a large quantity of shells in 1863 including 80 to 100 shells (some conical) for the rifled (6-inch bore) 32-pounder, about one hundred 8-inch-diameter shells and a few 9-inch shells (Appendix A-2, letters 11 and 16). Shells, unlike solid shot, were hollow and filled with gunpowder. They were designed to damage or destroy a target through the force of the explosion of the shell and not just the impact. These were especially effective against wooden ships and fortifications (Bell 2003:43).

A total of 25 round artillery shells have been recovered from the site. Nineteen round shells were recovered in 2009. Another 6 shells were recovered by a dredge from the bow area of the site in 2011 (Tirpak 2011). The majority of the shells recovered from the site are from two of the types of cannon carried by *Westfield*: 7 shells fit the 8-inch smoothbore Columbiads, and 17 shells are for the 9-inch Dahlgrens. The other shell is a 13-inch mortar (Figure 227) collected by the electromagnet from grid 106. The mortar shell, a reminder of *Westfield's* role in the Union mortar flotilla on the Mississippi River, was not fused. The 9-inch shells are the most common type of ordnance recovered from historic sites, with 2,000–3,000 surviving examples. The 8- and 13-inch shells are uncommon with fewer than 500 known examples: fifty to one hundred fifty 8-inch shells and one hundred fifty to five hundred 13-inch mortar shells are documented (Bell 2003:33).

Only fused shells should have been stored on deck. Any shell lacking a fuse presumably was in the shell locker at the lowest deck level when the ship was destroyed. At least ten 9-inch shells were

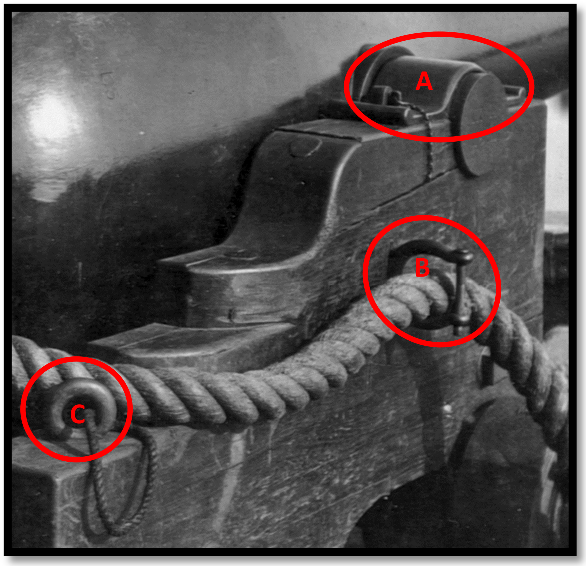

Figure 223: Marsilly Carriage Details: A-Cap Square, b-Breach Rope Guide, c-Eyebolt. Image courtesy of the National Archives, from the Mathew Brady Civil War Photos collection.

Figure 224. Cap square
(Artifact 103-070; scale cm)

Figure 225. Breach Rope Guide
(Artifact 107-014; scale Inches)

Figure 226. Eye Bolt
(Artifact 122-048; Scale Inches)

Figure 227. 13-Inch Mortar Shell
(Artifact 106-002; scale cm/dm)

Figure 228. Wooden Fuse Hole Plug
(Artifact 154-001.2)

fused and full of powder, indicating they were ready for use and probably were stored on the aft deck near their intended guns. At least two 8-inch shells were fused, suggesting they were on the forward deck when the magazine exploded. Live shells, referred to by the USACE as Munitions and Explosives of Concern (MEC for short), were quickly rendered inert by Marine EOD specialists without destroying the artifacts. The relatively small quantity of shells recovered by archeologists might be testament to the thoroughness of the Confederate salvers. Three empty shells were recovered with wooden plugs still inserted in their fuse holes indicating they were stored below deck when the forward magazine exploded. The remains of one plug (far left in Figure 228) clearly show the impression of threads from the shell's fuse bushing. These thread marks are not accidental. The Ordnance Instructions for the United States Navy required that empty shells "be stopped by a plug of *very soft* wood, well coated with a mixture of oil and tallow, *screwed* into them" (U.S. Navy Department, Bureau of Ordnance 1864: 24, italicized in the original).

Four of the 9-inch shells were concreted to their respective sabots (e.g., Figure 229), including one recovered from the base of the cannon's bore. Wooden sabots were affixed with tin straps to the base of each shell, opposite the fuse. Remnants of tin straps and a tin band around the fuse can be seen in Figure 229 as a slight stain on the shell. Tack holes where tin straps were fastened to the edge of a sabot can be seen in the side view of Figure 230. The alignment maintained by the sabot and straps kept the fuse pointed away from the firing charge, hopefully assuring the shell did not ignite while in the muzzle. Iron concretions protected the surviving sabots from *teredo* consumption, including a fused 9-inch shell on a sabot inside a wooden passing box (Figure 231), one of the best examples of wood preservation in the artifact assemblage. Another 9-inch shell (Artifact 121-002) was discovered concreted to a sabot, with a wooden plug in its fuse hole, and stored inside of a passing box. Passing boxes were used to temporarily store shells while passing them up to the gun deck. The fact that the latter shell had not been fused suggests it was stored in the aft magazine when the ship was destroyed.

Seventy-one brass fuses have been identified within the artifact collection. All the fuses are the standard U.S. Navy watercap type issued for naval shells (Figure 232, for example). The watercap fuses were an improved version of the naval fuse designed by Cyrus Alger and used during the Mexican-American War. The timing mechanism, or wick, inside each brass fuse consisted of a tightly wound plug of paper infused with gunpowder (Figure 233). The burn time of each fuse was controlled by the length of the paper wick.

A watercap that prevented moisture from entering the fuse was sealed by a lead safety patch stamped with the burning time in seconds (Figure 234). Twenty-one fuses retained their lead safety patch with burning times of 5 and 15 seconds clearly legible. Slightly more than half of the lead fuse caps recovered from the site came from fused shells, which appeared to offer a more protective environment due to their relatively stable positions. The lead would have been removed from a fuse shortly before firing a shell, as the fuse was ignited by the muzzle flash. For example, the fused shell in the Dahlgren bore did not have a lead cap in place, despite the protection afforded by its location.

FIGURE 229. 9-INCH SHELL ON SABOT
(PHOTOGRAPH BY AMY BORGENS)

FIGURE 230. SABOT (TOP AND SIDE)
(ARTIFACT 130-001.005; SCALE INCHES)

FIGURE 231. SABOT IN PASSING BOX
(ARTIFACT 130-001)

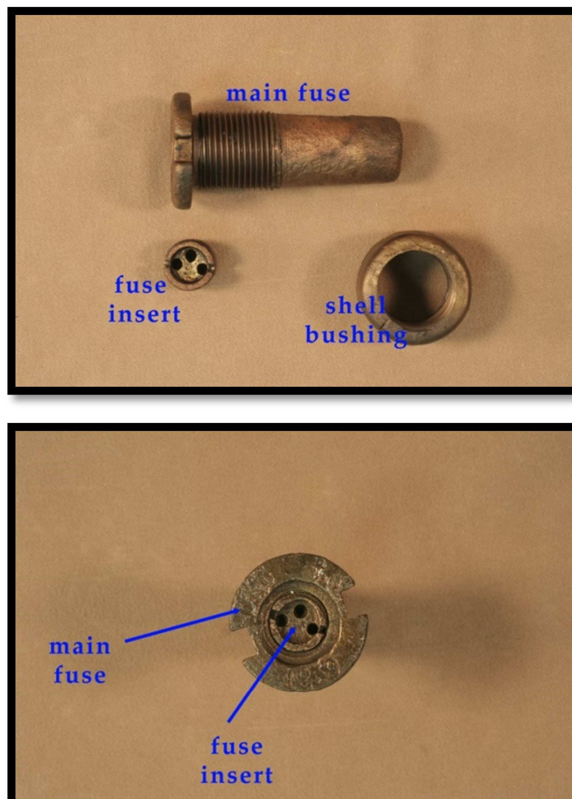

FIGURE 232. WATERCAP FUSE
(ARTIFACT 109-80)

FIGURE 233. FUSE AND PAPER WICK
(ARTIFACT 104-059A)

FIGURE 234. LEAD SAFETY PATCH
ON 5-SECOND FUSE
(PHOTOGRAPH BY AMY BORGENS)

FIGURE 235. CANISTER SHOT
(ARTIFACT 121-048; PHOTOGRAPH BY
CHRIS CARTELLONE AND KIRSTEN ATWOOD)

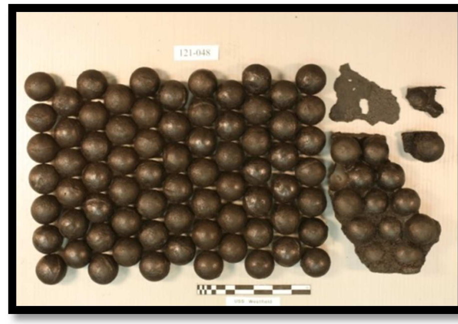

FIGURE 236. CANISTER SHOT DISASSEMBLED
(ARTIFACT 121-048; SCALE INCHES)

FIGURE 237. CANISTER SHOT EXAMPLES
(ARTIFACT 106-006 TOP;
104-019 BOTTOM; SCALE INCHES)

FIGURE 238. GRAPE SHOT STAND
(ARTIFACT 121-049; SCALE CM)

Clearly the cap had been removed prior to loading the cannon. The fuse in Figure 232 is shown disassembled to illustrate the bushing, normally residing in a shell's fuse hole until it was time to arm the shell, and the threaded brass insert with three holes exposing the wick to muzzle flash. The fuses from *Westfield* typically have 14 threads, measure 2.4 inches long, and have a maximum diameter of 1.25 inches at the head of the fuse. The shaft measurement varies with each individual fuse and can range from 0.63 to 0.80 inch in diameter. Each fuse is typically stamped ORD with a manufacturing date and an anchor to denote naval use. Many of the fuses from *Westfield* retain these marks and are stamped 1861 or 1862.

Confederate prize records also recount the collection of solid ferrous shot, grape, and canister shot. At least 63 artifact concretions containing solid iron shot were recovered including disarticulated single balls and clusters of shot that were concreted together. Individual grape and canister shot, as well as complete grape and canister assemblages, are represented. These were antipersonnel rounds, designed to be fired from smooth bore cannons, used to damage a vessel's crew and/or rigging. For the Civil War period, the round shot used in canisters was similar to grape shot except that it was smaller and loosely packed in a sheet tin cylinder (Bartleson 1972:115). Some small-diameter shot may also be associated with the use of shipboard howitzers. It is uncertain whether *Westfield* carried a howitzer; however, a "fighting bolt" used to quickly shift the gun from a land artillery carriage to a marine carriage was among the items salvaged in 1863 (Appendix A-2, Letter 16). The fighting bolt connected a howitzer to its carriage in place of trunnions.

Ten complete or partial canister shot have been identified. Diameters of shot represented include 1.3 and 1.5 inches. Several of these were recovered with portions of their outer tin casing intact. One of the best-preserved examples of a complete canister shot (Artifact 121-48) is shown prior to conservation in Figure 235. It measures 7.3 inches long and has a diameter of 7.9 inches. The tin casing does not generally survive conservation. Figure 236 shows the same artifact disassembled after conservation. Only a small fragment of tin survived. This canister contained 86 solid iron shot. Two other conserved examples (Figure 237) illustrate how solid shot was packed in sawdust within the canisters.

Grape shot was much less common than canister shot in the artifact assemblage. Only five examples of iron shot were large enough that conservators classified them as grape shot. An empty iron stand, designed to hold grape shot for a 9-in Dahlgren, also was recovered from *Westfield* (Figure 238). It was found concreted to a 2.5-in solid shot and fragments of rope and canvas. The maximum diameter of its base, if not damaged, would have been 8.56 inches. Grapeshot for the naval 9-inch Dahlgren was held in place by a "quilted" sailcloth enclosure and measured 10.75 inches in length with a diameter of 8.65 inches. The standard diameter grape shot for the 9-inch quilted round is 2.80 inches (Bell 2003:99, 109).

Small Arms

A variety of small arms were used by the U.S. Navy and Marines during the Civil War and included not only U.S. manufactured weapons but also British arms, such as Enfield rifles, captured from blockade runners. Arms provided for blockade vessels were arranged by the Bureau of Ordnance and Hydrography (McAulay 1999:60-61). Initial firearms supplied to the navy between 1861 and 1863 included both rifled and smoothbore muskets (predominantly Springfield), Colt revolvers, Remington revolvers, Jenks rifles and carbines, Hall carbines, Spencer rifles, and Sharps rifles (McAulay 1999:60-61; 65-66, 103-104). Weapons known to have been carried by vessels of the West Gulf Blockading Squadron, and listed in McAulay's inventory (1999:165-172), included Plymouth rifles (*Fairy*), Springfield muskets and Maynard carbines (*Harriet Lane*), and Springfield muskets and Colt Army pistols (*Sachem*) (1999:167). A historic report mentions that some small arms were recovered from *Westfield* in haste during evacuation of the gunboat yet the account indicates these arms may have been readily accessible by the crew and not necessarily what was in ships stores (*Boston Journal* 1863:2). The exact models and types of small arms carried on *Westfield* are not currently known by the authors.

Two firearm fragments (Artifacts 110-015 and 138-61) are among the artifacts recovered during the investigation of the site. The more intact firearm, Artifact 138-61, represents a portion of the percussion lock area and barrel of a longarm (Figure 239). It is incomplete and was partially encased within a concretion that was broken into two pieces. The overall length of the conserved firearm is 9.50 inches. The wood gunstock is nonextant and there is no evident lockplate. The barrel itself is ferrous metal but portions of the concretion were cast with epoxy. The artifact includes a section of the gun barrel at the breech, its associated breech plug, and the cone seat for the (nonextant) percussion lock. This component of the lock was attached to the barrel and not the lockplate; what appears to be a cupreous brazing plate was still intact when the artifact was initially examined.

The barrel is heavily eroded at the breech to expose the threading of the breech plug. Though it is difficult to discern, the barrel is faceted and appears to have been octagonal in shape. The breech plug tang still contains the tang screw and a portion of the once ferrous (and now cast) trigger plate or trigger guard to which it was fastened. The breech plug tang is .50 inches wide with a rounded end. The width of the barrel at the breech is 1.50 inches. The bore diameter is .75 inches. A portion of the rear block gun sight is intact and is dissimilar to those used on the major U.S.-manufactured longarms supplied to Confederate and Union troops – it is reminiscent of those used on Belgian, Prussian, and Austrian weapons of the early to mid-nineteenth century. Large quantities of such "continental" arms were imported the during the Civil War and included weapons such as the Model 1854 Austrian Lorenz rifle and .69-.71 caliber Austrian and Prussian longarms (Bilby 1996:62; Moller 1988:98). The Lorenz rifle, though of a much smaller caliber than 138-61, has a similar rear block sight. The poor preservation and fragmented condition of this artifact has made it

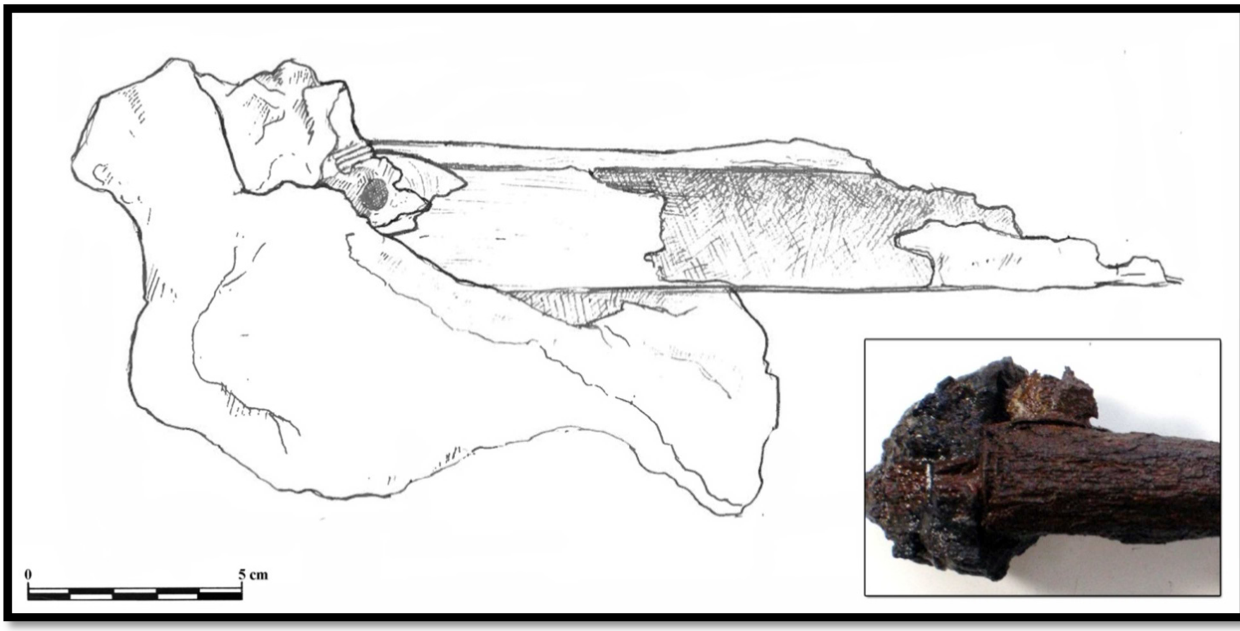

FIGURE 239. CONCRETED FIREARM FRAGMENT (ARTIFACT 138-61).
INSET IMAGE ILLUSTRATES THREADED BREECH PLUG ON UNDERSIDE OF WEAPON
(SKETCH BY AMY BORGENS, PHOTOGRAPH BY BRIANA SMITH)

FIGURE 240. BREECH END OF FIREARM BARREL FRAGMENT (ARTIFACT 110-015)

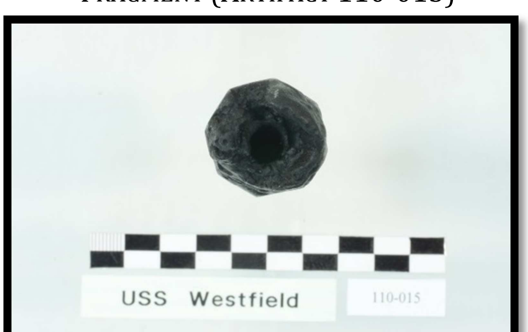

FIGURE 241. BROKEN END OF FIREARM BARREL (ARTIFACT 110-015)

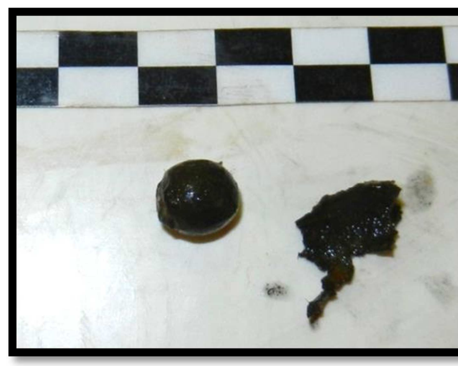

FIGURE 242. LEAD SHOT AND WADDING RECOVERED FROM BARREL FRAGMENT SHOWN IN FIGURES 240 AND 241. (ARTIFACTS 110-015.1 AND 110-015.2)

FIGURE 243. LEAD MUSKET SHOT (ARTIFACT 123-004.4)

difficult to identify. It is inconsistent with the major arms types supplied to the navy and marines early in the Civil War. The crude form of the cone seat, with brazing, may indicate this was a conversion firearm. The bore diameter suggests it is a musket.

A second firearm fragment (Artifact 110-015; figures 240 and 241) is only the rear portion of the barrel at the breech where it fastened to the breech plug. The breech plug is not preserved but remnants of it were attached to the barrel and observed by conservators. The octagon-shaped barrel fragment has a length of 5.13 inches and has a maximum width of 1.00 inch. The rear of the barrel was threaded for its attachment to the breech plug and has an interior diameter of approximately 0.63 inches at this juncture. A lead shot recovered from inside the barrel with a fragment of wadding (Figure 242) has a diameter of 0.37 to 0.41 inches. The wadding consists of a plain fine weave. The fibers are heavily impregnated with iron and dirt. Cleaning this material would have damaged the fibers and separated the weave, so it was preserved with silicone oil without further treatment. The fibers are short and appear to be cotton or linen, most likely cotton.

A second damaged lead shot (Figure 243), of which just more than half remains, was recovered from grid 123. Artifact 123-004.4 was cut in half, which has had the effect of creating an irregular diameter varying from 0.63 to 0.75 inches. This size of projectile, though damaged, is consistent with musket caliber shot of the period.

Miscellaneous

A copper knife was recovered from Unit 128 (Figure 244). This is a rather unique artifact, as most knives of the time would have been made of much harder steel. Copper knives were part of the standard tool kit supplied to each powder magazine. The Ordnance Instructions for the United States Navy, Tables of Allowances of Ordnance Equipments and Stores lists an allowance of one copper knife for each magazine (U.S. Navy Department, Bureau of Ordnance 1864: cii). Given that the forward magazine exploded, this knife must have come from the aft magazine. The fact that it survived in good condition, minus its wooden handle, suggests that no explosion occurred in the aft magazine.

Over one-hundred miscellaneous fragments of lead were recovered from *Westfield*. While many were intrusive fishing weights, the purposes of others could not be determined. Most of the recovered lead appeared as non-diagnostic scraps of metal. Of the few that did contain diagnostic features, only one can be potentially recognized as having a specific function. The lead sheet shown in Figure 245 contains a unique impression resembling a fabric weave, providing a clue as to its function. The Union Navy lined powder magazines aboard naval vessels with lead to prevent accidental sparking (U.S. Navy Department, Bureau of Ordnance 1864: III-48). Coarse woolen baize cloth was hung as a screen over entrances to prevent sparks from entering the magazine. The imprint might have been caused by stacking powder barrels on a woolen baize cloth laid down on the magazine floor or by stacking woolen powder cartridge bags directly on the lead sheeted floor.

FIGURE 244. COPPER POWDER KNIFE (ARTIFACT 128-019)

FIGURE 245. LEAD SHEET WITH FABRIC IMPRESSION (ARTIFACT 118-157)

FIGURE 246. BULLET MOLD (ARTIFACTS 139-005 AND 119-021)

FIGURE 247. EXAMPLES OF UNION BELT AND CARTRIDGE BOX PLATES (ARTIFACTS 6 AND 107-024)

FIGURE 248. REPRODUCTION EXAMPLE OF SNAKE BUCKLE (UNKNOWN PHOTOGRAPHER)

FIGURE 249. TWO ARTIFACTS ASSOCIATED WITH SNAKE BUCKLES (ARTIFACTS 111-064 AND 135-003; SCALE MM/CM)

A hand-held brass bullet mold was recovered in two pieces from grids 119 and 139 (Figure 246). The right half of the mold is complete though the handle is bent (Artifact 139-5). The handle is broken on the left half of the mold (Artifact 119-21). The length of the complete half is 7.5 inches. The handles likely had wooden grips and may have been similar to a locally produced mid-nineteenth-century example from the Gillespie County Historical Society on display at the Bob Bullock Texas State History Museum in Austin, Texas. The mold would have created a conical-shaped lead projectile approximately 1.35 inches long with a diameter of 0.60 inch.

Shipboard Life

The vertical erosion of site 41GV151, the high-energy environment within which it is situated, and the historic salvage of the vessel did not preclude the discovery of large quantities of many smaller artifact types. Examination of the artifact assemblage has demonstrated the presence of such items. These objects were dispersed on the surface, atop or within the shell hash, and were also found to collect in the scour pockets and recesses around the larger artifacts. The wreck site also yielded smaller unique artifacts that provide insight into the ship's personnel, their tasks, and tools of their trade.

Westfield's Crew

Few personal items were excavated from the site of USS *Westfield*. Those that were recovered are fragmentary at best. Using what remains and historical documents, archeologists have pieced numerous aspects about life aboard *Westfield*. When USS *Westfield* sailed away from New York City in early 1862, 130 sailors, officers, and Marines were onboard. At the time, most naval recruits were unskilled and untrained. Few records were kept of the sailors. Better records were kept of the officers, from the letters of Commodore William Renshaw and the Union records of their deaths following the Battle of Galveston. Thirteen officers, seamen, and firemen, including Renshaw, lost their lives that day.

Surprisingly, researchers know more about the Marines on *Westfield* than the other crewmembers. The Marines acted as ship guards, manning batteries and participating in onshore operations. They were employed in blockade duty and participated in shipboard battles. The Marines filled many roles onboard, sometimes a soldier or sailor, or at other times, a coal-heaver. The lives of the Marines onboard *Westfield* were revealed in a very unique way. A journal, written by the Marine Henry O. Gusley, recorded a daily history of *Westfield*, from the ship's commissioning to her sinking. Most of the ship's history comes from the diary. Seized by the Confederates after the Battle of Sabine Pass, the journal was published in the Galveston Tri-Weekly News in installments. The journal provided Texans a perspective of a Northerner, which they discovered was rather similar to their own.

Personal Clothing

Union plates, although government issued, were the most personal artifacts found during the excavations. Plates encompass both belt buckles and decorative plates used for uniforms, and the term is generally used in place of the name “buckle”. They were made by stamping the design into a brass plate to create a shell, attaching the hooks or loops onto the back, and then filling the shell with lead. At the beginning of the war, the Union issued plates with a vast array of decorations. Individual states created their own plates but most were unable to resupply their soldiers with replacements. In addition, the federal government issued the common plate, with the large letters “US” stamped into the front, identical to the ones found on *Westfield*. Waist belt plates are the most commonly known examples, thus the term "buckle". These plates adorned a utility belt that held equipment, such as a saber, bayonet scabbard, or an ammo cartridge box. These had three hooks on the back of each plate, two on one side to attach the plate to the leather belt and one larger hook to secure the belt once placed around the waist. Cartridge box belt plates were placed on the shoulder strap holding the cartridge box, and cartridge box plates were on the box, both as a decoration and as a weight to hold the covering flap shut. These plates had two small loops on the back, one on either side, to attach them to the cartridge box. Other types of plates include sword belt plates and shoulder and cross strap plates, used for carrying a sword, bayonet, or powder flasks.

Eleven plates were dispersed in the northern portion of the wreck site. Six plates were used on cartridge boxes and 5 plates are the standard U.S. military buckles (typically the Model 1856) issued for belts. Figure 247 displays examples of “U.S.” marked belt and cartridge box plates, differentiated by the different types of clasps either on the back or sides of the plate. Those marked with the “U.S.” symbol appear to be lead but once had a shell of brass overlaid above the lead. Traces of this cupreous material can still be seen on closer examination. The buckles from the cartridge boxes are all complete. All but one of the belt buckles is heavily eroded and damaged.

The British blockade runners supplied the Confederate troops with snake or “S” shaped buckles, which were attached to two oval links on either side of the “S” (Figure 248). Two heavily eroded pieces (Artifacts 111-064 and 135-003) of this buckle type were found on the *Westfield* site and may have been taken off a British blockade runner, as the Union personnel were not above using British plates also (Figure 249). Since these artifacts were not found together, archeologists cannot confirm if the pieces represent two separate buckles or one buckle that became dispersed following *Westfield*'s explosion. The midpoint of one long side on the belt plate loop shows a weld point, and the metal is thicker at that point. In addition, a break point is seen next to the weld point. This is most likely the original attachment to a small circular loop where the snake buckle would have attached. Another identical loop on the other side of the snake belt plate would have completed the attachment to the belt.

One other artifact resembles a buckle (Artifact 123-041). Unfortunately the piece is poorly preserved and only survives as an outer frame. The frame may have held a decorative item as indicated by three triangular tabs that line the interior, similar to the image in Figure 250.

Only a few other clothing artifacts were recovered from *Westfield*. Most of these came from military equipment. Artifact 108-067 consists of a small brass hook and plating that once wrapped around a bayonet scabbard (Figure 251). As seen in Figure 252, the hook was used to attach the bayonet scabbard to a leather belt accessory known as a frog.

Artifacts 111-065 and 131-096 are two brass buttons. These button types were commonly used on Union cartridge boxes to secure the outer leather flap to the base of the pack (Figure 253). In addition to regular stitching, Union cartridge boxes used brass grommets to secure the pack to a waist belt. Artifact 39.1 represents one of these grommet types and may also have come from one of these cartridge boxes (Figure 254). The artifact contains a tubular rivet or cap that was clamped into a stud to secure two pieces of leather.

At first, Artifact 110-154 appeared as a scrap of non-diagnostic leather. Only after conservation did stitching holes and cut edges become apparent. This artifact proved to be a left heel from a leather boot (Figure 255). During the Civil War, most soldiers' footwear did not contain a proper left or right, which allowed a shoe to be worn on either foot. The indication that this artifact belonged to a left sided sole, may mean that the boot once came from an officer.

Two of the more unique clothing artifacts came from a type of backpack that was produced by the British manufacturer TG-Isaacs, Campbell & Co. These backpacks are thought to have been used exclusively by the Confederacy since the manufacturer did not sell them to the Union. Most of these backpacks entered the Confederacy through blockade runners. This raises the question on how a backpack of this type came aboard *Westfield*. The backpack may have been confiscated from a captured ship or from a prisoner of war. The recovered artifacts (Figure 256) consist of a brass clasp (Artifact no. 110-122) and a brass pack hook (Artifact 120-296). The brass clasp loop once formed the end of a backpack strap that was pulled over a soldier's shoulder and then connected to a brass pack hook on the soldier's lower back (Figure 257). Since the artifacts were found separately, archeologists cannot confirm if these pieces came from the same backpack.

Personal Items

Marines aboard *Westfield* were issued standard oil bottles to maintain and lubricate their Enfield muskets. Although heavily eroded, a brass top and cap (Artifact 132-001.02) from one of these bottles survived (Figure 258). In original form, the oil bottle contained a rolled sheet of zinc for the bottle and a threaded brass top and cap. The cap contained vertical grooves along the rim to allow for easy fingertip removal. Attached to the inner cap, a steel applicator allowed oil to be removed and applied to the musket (Figure 259).

FIGURE 250. BRASS BUCKLE FRAME
(ARTIFACT 123-041)

FIGURE 251. BRASS HOOK FOR BAYONET FROG
(ARTIFACT 108-067)

FIGURE 252. COMPARATIVE EXAMPLE OF AN INTACT
BAYONET SHEATH WITH BRASS FROG ACCESSORY
(IMAGE COURTESY OF "THE HORSE SOLDIER")

FIGURE 253. BRASS BUTTONS FROM
AMMO CARTRIDGE BOXES
(ARTIFACTS 111-065 AND 131-096)

FIGURE 254. BRASS GROMMET (ARTIFACT 39.1)

FIGURE 255. LEATHER HEEL FROM LEFT SIDED
BOOT (ARTIFACT 110-154; SCALE INCHES)

FIGURE 256. BRASS CLASP AND PACK HOOK
FROM CONFEDERATE BACKPACK
(ARTIFACTS 110-122 AND 120-296)

FIGURE 257. REPLICA CONFEDERATE BACKPACK (IMAGE COURTESY OF C & D JARNAGIN COMPANY)

FIGURE 258. BRASS TOP AND CAP FROM ENFIELD OIL CAN (ARTIFACT 132-001.02)

FIGURE 259. REPRODUCTION ENFIELD OIL CAN (IMAGE COURTESY OF S & S FIREARMS)

FIGURE 260. BRASS CYLINDER FROM ENFIELD MUSKET ROD (ARTIFACT 133-128)

Part of maintaining an Enfield musket, included running a ramrod down the barrel with a cleaning jag to swab out debris. A fitting from one of these rods was recovered from *Westfield* (Artifact 133-128). This fitting consists of a small brass cylinder with internal threading on one end and two small pin holes on the other. These pin holes pierce through the cylinder's diameter. The side with the holes is crushed, but the rest of the artifact is relatively well preserved. The artifact was designed to secure a brush or cleaning jag to the rod. The internal threading allowed the cleaning jag to be screwed onto the rod's tip. To secure the cylindrical fitting to the rod, a small iron pin was pushed through the holes in both the fitting and the rod (Figure 260).

Enfield muskets commonly had a leather sling that attached just forward of the trigger guard, and extended to the foremost barrel band. The sling was used for securing the musket to a Marine's back and for general handling purposes. A brass hook from one of these slings was recovered intact (Artifact 120-272). The hook was originally fixed to the end of the leather sling, which was looped through a ring at the musket's forward band, and then back over itself, where the hook was finally attached to one of several adjustment holes. If a Marine needed more or less length in the sling, he could detach the brass hook and reattach it to a different hole (figures 261 and 262).

An assortment of other artifacts may have come from seaman's storage chests, foot lockers, or other types of boxes. All of these artifacts are cupreous and were found scattered across the site. As with other artifacts, this disarticulation does not allow archeologists to determine with certainty how many original objects are represented in the collection. Despite this, four hinge fragments (Artifacts 102-062, 105-023, 106-031, and 107-028.1) are of the same size, and design, and if joined represent two complete hinges with an upper and lower portion (Figure 263). These fragments appear to have come from the same original object. One other hinge (Artifact 109-103) of a different type came from a different object (Figure 264).

Four locking devices were also found (Figure 265). A cupreous hasp (Artifact 134-035) for a padlock clasp contains two holes on one end. One of these holes is filled with brass, suggesting that the other portion of the hasp was also made of brass. The other end has decorative beveling, flat on one side and concave on the other, and a long ellipse opening to allow a loop to enter and a lock to be attached. Another lock type consisted of a small hook with a flat backside and a decorative embossed front (Artifact 128-063). The hook was once fixed to a box and rotated counterclockwise, so that the embossed side faced outward.

The other locking devices consisted of fragments from two different sized rectangular lock plates. The larger lock plate (Artifact 106-027) contains mounting points suggesting that the artifact came from the back portion of a lock assembly. The smaller lock plate (Artifact 128-062) contains an oval or key entry that indicates that the object is from the front of a lock assembly. Falling into the same category as locks, a small cupreous key (Artifact 120-295) was recovered but cannot be confirmed

FIGURE 261. BRASS HOOK FROM MUSKET SLING (ARTIFACT 121-272)

FIGURE 262. EXAMPLE OF MUSKET SLING AND HOOK (IMAGE FROM UNIDENTIFIED AUCTION)

FIGURE 263. POSSIBLY ASSOCIATED BRASS HINGE PIECES (ARTIFACTS 102-062, 105-023, 106-031, AND 107-028.1)

FIGURE 264. INTACT BRASS HINGE (ARTIFACT 109-103)

FIGURE 265. ASSORTMENT OF BRASS LOCKING DEVICES (ARTIFACTS 106-027, 128-062, 128-063, AND 134-035)

FIGURE 266. BRASS SKELETON KEY (ARTIFACT 120-295)

as belonging to one of these boxes or from one of the ship's doors (Figure 266). The key contains three decorative bands around the shaft and is mostly complete, with the exception of a missing portion of the ring.

Within a concreted mass, conservators recovered three brass artifacts (110-154.1). One of these artifacts came from a small personal brass oil lamp (Figure 267). Circular ventilation holes are spaced unevenly around the circumference of the bottom indicating that they were drilled or punched by hand. The upper portion is designed to receive a cap that held the cotton fabric wick in place. The other two objects consist of a small yet thick screw with tight threading, and an angle bracket with three mounting holes. It is not clear if these other two artifacts were ever associated with the lamp.

One of the most surprising personal artifacts discovered, consisted of burned paper pages and what appears to be a brass book spine (Artifact 120-300). Although burned almost beyond recognition, the surviving fragments of this book are remarkable considering the violent destruction of *Westfield* (Figure 268). One small fragment revealed grid marks and possible numbers indicating that the object may have once been a ledger of sorts.

In order to entice men to join the Navy, recruitment offices posted flyers throughout the Union declaring that in addition to regular pay, enlisted men would gain prize money through the capturing of enemy ships (Figure 269). Captured vessels and their cargoes would be sent to a U.S. held port, and eventually auctioned. The money would be distributed down the chain of command based on navy personnel's rank, position, and involvement in the actual capture. This meant that nearby Union ships and superiors not present at the time of capture, would receive a share of the prize money. To get around this rule, sometimes Union captains pursuing a prize, would stop to collect cotton bales that had been thrown overboard by a pursued vessel to lighten their load. Known as "waif cotton", these bales were subject to civilian salvage laws which granted the captain and his crew the full proceeds of the prize money (Hall 2014:81). There is a good chance that *Westfield*'s crew partook in this type of salvage. In Marine Henry Gusley's journal, he described several events of when cotton was confiscated and brought aboard *Westfield* (Cotham 2006:114, 121). Conservators found a large concreted mass (Artifact 107-009) of cotton bale ties linked together by numerous iron bands that once secured cotton (Figure 270). While the arrangement of the artifact indicates that the ties and bands were gathered together for storage, the artifact's presence also implies that cotton bales were aboard *Westfield* during or near the time of the vessel's sinking.

Food and Drink

Life onboard a navy ship had one good advantage: regular, and generally good, meals. After swabbing the deck, the sailors had a breakfast of weak coffee and hard tack, or biscuits. Dinner was

FIGURE 267. FRAGMENT FROM BRASS OIL LAMP, BRASS SCREW, AND BRASS BRACKET (ARTIFACT 110-154.1)

FIGURE 268. BURNED BOOK WITH BRASS SPINE (ARTIFACT 120-300)

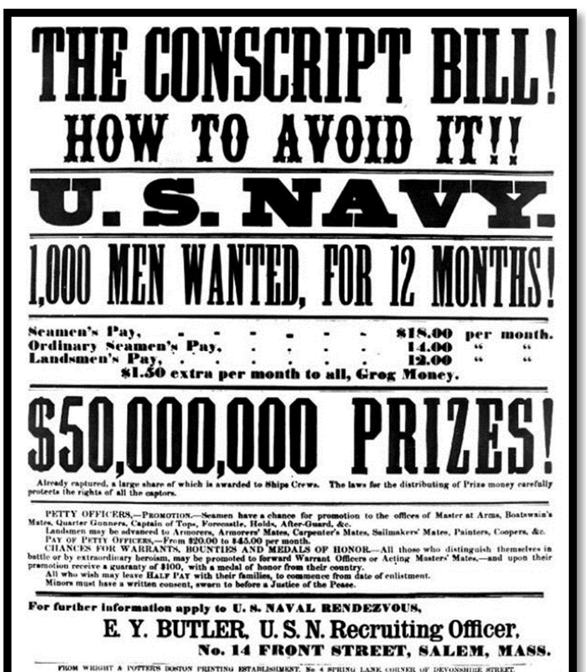

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FIGURE 269. EXAMPLE OF NAVY RECRUITMENT POSTER (IMAGE COURTESY OF BLUEJACKET.COM)

FIGURE 270. COTTON BALE TIES; EPOXY CAST ON LEFT OF MOSTLY DECONCRETED OBJECT; SEPARATED COMPONENTS ON RIGHT (ARTIFACT 107-009)

FIGURE 271. LARGER CYLINDRICAL NAVAL STOVE COVER (ARTIFACT 110-150; SCALE CM)

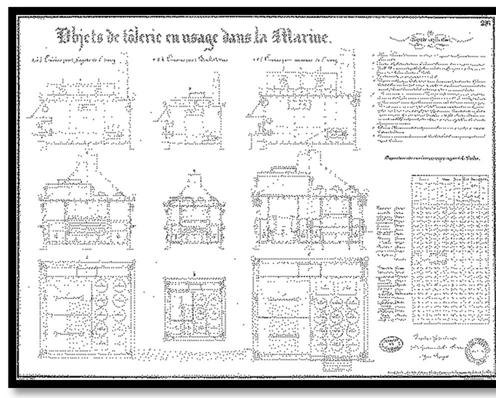

FIGURE 272. FRENCH NAVAL STOVE FROM 1835 (IMAGE COURTESY DIRECTION DES CONSTRUCTIONS, PORT DE TOULON: OBJETS DE TOLERIE EN USAGE DANS LA MARINE, COLLECTION 98 1ERE SERIE)

FIGURE 273. SMALLER NAVAL STOVE COVER (ARTIFACT 119-126)

the largest meal of the day and usually contained heavier foods of salted beef or pork, rice, beans, bread, pickles, and pudding. Supper was a lighter meal. Sailors ate together in a group of somewhere between 5 and 20 sailors, called a mess. While plates, spoons, and forks of a mess were stored together in a common chest called a kid, sailors commonly used their own knives to cut and eat their food.

Alcohol or spirit rations for sailors were discontinued in July of 1862, except for medicinal purposes. Henry Gusley remarked that the sailors were very much opposed to the change, citing that the varying climates and conditions, and the poor quality of food and water encountered in life onboard a navy ship, justified the small alcohol ration that was provided.

Stove

To feed *Westfield*'s large crew, the vessel required a shipboard kitchen or galley. Two small cast iron artifacts were recovered from what is believed to have been the starboard central side of the ship. Conservators believe that both of these objects served as cover plates from a large marine stove located near this vicinity of the wreck site. The larger artifact (110-150) contains a square base that is largely damaged, but rounded corners and a central raised circular portion indicate that the object was designed to fit over something without moving (Figure 271). Similar examples from 1835 can be found in French naval stoves for shipboard use (see Figure 272). These stoves contained built-in cylindrical recesses into which pots were placed. When not in use, square and round cover plates covered these recesses. The smaller artifact (119-126) was once part of a round cover plate that if complete, contained an internal diameter of approximately twelve inches (Figure 273). If these artifacts are close to their original position, *Westfield*'s kitchen may have been situated on the starboard side of the vessel.

Food Remnants

Archeologists recovered a large quantity of bone material that was scattered across *Westfield*'s wreck site. All of this bone material is fragmentary and most is believed to be intrusive from local fauna such as birds that died and settled into the Texas City Ship Channel. Most historic bone remains would not have survived into the present due to Texas' warmer marine environments. However, out of this collection, three of the bone fragments (Artifacts 122-080.1, 129-031, and 130-036) appear to have come from cattle, and contain evidence that they may have been butchered and cooked (Figure 274). If these bones were burned either by intentional galley cooking aboard *Westfield* or from the vessel's later destruction, the bones may have become hardened enough to preserve them into present day. Without further tests on these fragments, a definitive conclusion is not readily available. Finding historic cattle bones on *Westfield* would not be surprising to archeologists. Sailors often found or stole fresh provisions from the nearby land. The Marine, Henry Gusley, remarked on the vast quantity of food found in Texas: “The cotton was soon transferred

FIGURE 274. BUTCHERED CATTLE BONE FRAGMENTS (ARTIFACTS 122-080.1, 129-031, AND 130-036)

FIGURE 275. DARK GREEN WINE BOTTLE (ARTIFACT 121-025)

FIGURE 276. BLACK ALCOHOL BOTTLE (ARTIFACT 132-396)

FIGURE 277. SODA OR MINERAL WATER BOTTLE (ARTIFACT 140-013)

FIGURE 278. MISCELLANEOUS CERAMIC SHERDS (ARTIFACTS 134-046, 120-280,103-039, 139-011, 124-033, 109-123, AND 132-001.7)

FIGURE 279. ELECTROPLATED SILVER CONDIMENT SHAKER CAP (ARTIFACT 109-010)

FIGURE 280. EXAMPLE OF A VICTORIAN ELECTROPLATED CRUET MADE IN 1861 (IMAGE COURTESY OF CHANTICLEER PRESS, INC.)

aboard the *Westfield*, and the oyster bed underwent a good raking. The immense quantity of geese, ducks, &c., in the vicinity, also invited some of the ship's crew ashore for a day's sport. Oysters stewed, fried, roasted and on the shell were the order of the day, and today promises to be a repetition. Fresh beef is also obtainable and has been obtained." - Henry Gusley, October 28, 1862 (Cotham 2006:114).

Glassware

From 1833-1903, glass manufacture was one of the largest and most important industries in America (McKearin and Wilson 1978:68). During this time, the glass industry was highly competitive and highly secretive. Accordingly, records are scarce for glass production. The Civil War increased demand for glass products. The war was also a transition period in glass manufacture, and there were a variety of techniques used, resulting in a variety of qualities. As such, no characteristics exist for recognizing Civil War bottles. In addition, most glass does not have any identifying markings, including the glass from *Westfield* (Russell 1988:11, 13, and 15). This made identifying historic glass from the wreck difficult for conservators.

There are two essential ingredients for glass production, silica and alkali, in the form of soda, lime, potash, or pearl ash. Ordinary containers were made from green glass or bottle glass, referring to the composition, as opposed to the color. This green glass was naturally colored from the impurities and chemical nature of the ingredients; however, during the 1840s and 1850s, artificial glass colors became common. By the 1870s this trend had shifted toward more colorless or clear glass containers. A glass recipe for lighter green glass from 1867 calls for 12 parts of sand, 5 parts soda, 2 parts lime, and 10 parts sandstone. Darker green glass was produced by substituting the ash in the sandstone with lime. The dark green glass, exhibited by several examples found on *Westfield*, was tougher and used for alcoholic liquids; wine, port, ales, beers, and cider, for example.

Several fragments of light green glass were recovered from *Westfield*. The largest piece (Artifact 121-025), represents a one-third surviving section of a wine bottle (Figure 275). The glass is thick and heavy, and is missing the neck, rim, and most of the body. Significant portions of the base and kick-up are still intact. The breaks in the bottle show that unlike modern bottles, these 19th-century bottles have many imperfections, such as uneven wall thicknesses and bubbles contained within the glass. Several fragments were also found of darker green glass. The largest piece consisted on only the lower base (Artifact 132-396). This bottle contains very thick heavy glass that is opaque (Figure 276). Only the base, kick-up, and a small portion of walls are preserved. The kick-up has low sloping walls that are almost at 45 degrees from the walls of the bottle. A small, shallow pontil scar is visible on the outside showing from where the bottle was blown.

Conservators believe one of the more intact bottles (Artifact 140-013) recovered from *Westfield* is intrusive, but nonetheless historic. The bottle's color is a light bluish-green. The neck and rim are broken in multiple places and missing a few fragments, but the bottle is otherwise complete (Figure

277). A seam runs down both sides of the bottle, except for the rim, indicating the bottle was made using a two piece mold. There are air bubbles throughout the glass, with smaller ones concentrating in the body and a few larger ones in the base. The base is uniquely rounded so that the bottle cannot sit upright. This bottle likely held soda or mineral water.

Soda and mineral water bottles were introduced around 1850. They were made heavier and thicker to prevent explosion and breakage, and fitted with wire fasteners around a heavily collared mouth, to withstand the pressure of the carbonation. The majority of mineral water bottles range from 6-8.5 inches and could hold anywhere from 8-14 ounces. They were primarily aquamarine, green, or blue. However, their most diagnostic feature was the smooth or round base, preventing the bottle from being stood upright, an innovation developed in England (Van Rensselaer 1926:39-40; McKearin and Wilson 1978:238-239). This prevented the cork from drying out and shrinking, causing the liquid inside to lose carbonation or evaporate. They were usually produced using a two piece mold; the neck, shoulder, body and entire base was molded, before the thick collar was added by hand. The majority of these soda, or mineral water bottles, were imported from Great Britain, more so than those made in the United States or those made overseas for American companies. Sometimes referred to as ballast bottles, they are thought to have been imported from England as ballast due to their heavy weight. The majority of the round bottom base bottles date from the 1870s to the 1910s (Lindsey 2012), indicating that this example recovered from *Westfield* may be intrusive or deposited on the site during the demolition operations in the early 20th century. The preservation of the bottle, the only one which is almost complete, would indicate that this may be the case, having been spared from the initial explosion and salvage.

Ceramics

The few surviving ceramic fragments from *Westfield* were most likely standard issue items from the US Navy and imported from Europe. During the 19th century, American pottery, which rivaled Europe in texture, durability, hardness, and finish, could not compete with the supply of European pottery, despite the vast resources available in the US. The clay was mined by workmen, assisted by steam machinery and prepared by moistening, grinding, kneading, and dividing the clay into various size lumps required by a particular vessel. The lumps were shaped into vessels on a throwing wheel before they were dried and packed into a kiln for baking, causing the clay to become hard and tough (Freedley 1856:472-473).

Stoneware, one of the most common types of pottery in the 19th century, was fired at very high temperatures, vitrifying the clay and making it leak proof. This makes stoneware ideal for holding liquids. By this time, most of the flatware was made by casting the clay in molds before firing. For decoration, various glazes were used. While stoneware made strong, utilitarian vessels, they were not easily transportable and broke easily (Crouch 1992:20). The clay used for stoneware vessels was grey or buff-colored when fired and turned brown from iron oxide. Salt-glazed stoneware, developed in Germany and brought to Britain in the 1670s, was made by throwing salt into the kiln during firing. The salt vaporized at the high temperatures and settled on the surface of the pots forming a distinctive mottled glaze (Potteries Museum and Art Gallery 1999:8).

Other common types of ceramics represented on *Westfield* include porcelain, whiteware, and ironstone. Porcelain became more common in the 19th century, produced in a thicker variety, and therefore cheaper. Whiteware was also widespread. Fired at a low temperature, whiteware suffered from crazing or surface cracks that caused the clay to leak. Whiteware developed from pearlware which evolved from the prolific creamware of the 18th century. Whiteware, with creamware, pearlware, and stone china, dominate 19th-century ceramic assemblages and are frequently confused because the differences depend on a subjective observation of how much bluing is in the glaze. Ironstone was a very utilitarian and thick ware, more common in the later 19th century, from the 1870s to the 1900s. Between the 1850s and 1870s, plain ironstone seemed to replace transfer-printed wares and vessels were comparable in form and size. Except for porcelain, all fine wares from the 19th century were made in England (Miller 1980:2-4; Helen Dewolf 2012, pers. comm.).

The following fragments represent the most diagnostic or largest examples of different ceramics types recovered from *Westfield* (Figure 278). Artifact 134-046 consists of a small porcelain rim sherd. This fragment has a bend on the opposite end of the rim, where the original object may have sloped downwards to create the concave lower portion of a plate or bowl. Artifact 120-280 is one of the largest surviving ceramics in the collection. This sherd came from an ironware plate or platter that contained an original diameter of approximately 12.59 inches. The side opposite of the rim bends to slope down into concave lower portion of the plate. Perhaps the most diagnostic fragment, is Artifact 103-039. This small surviving fragment of whiteware was found by conservators with a fabric impression preserved in the concretion. The impression indicates that original fabric pieces were folded over, and possibly wrapped around the ceramic piece. This suggested to conservators that the plate was protected with a layer of linen while in cupboard storage. Unfortunately, the impression of the cloth did not survive conservation attempts. A second larger whiteware sherd, Artifact 139-011, contained an original plate diameter of approximately 9.84 inches. This plate is decorated with three blue annular lines; two around the edge, one thick and one thin, and one thin line where the sherd bends down into the lower portion of the plate. Artifact 124-033 is the largest ceramic piece recovered from *Westfield*. The stoneware sherd contains an exterior color of tan with a mottled glaze, and on the inner side, a dusky red or maroon glaze with horizontal striations or groves from the manufacturing turning process. The last two ceramic examples are both sherds of salt-glazed stoneware. Based on their design, these artifacts may have been associated with each other or with other examples of the same purpose. Artifact 109-123 was from the lower body and base of a large rounded pot container. The outer surface is colored light olive gray. The inner surface has steaks of orange and dark brown indicating that the color was unevenly applied with brushstrokes prior to firing. Towards the base, the painted streaks changed from angled to parallel with the base. The second salt-glazed fragment, Artifact 132-001.7, is a small rim sherd from a lid and contains the same colors as the previously mentioned artifact. Although small, the sherd is preserved well enough to see how the rim once sat on both the outer and inner portion of the pot container. The heavy lid may have belonged to a large crock pot used for vinegar or pickling (Helen Dewolf 2012, pers. comm.).

Tableware

Only one example of metal tableware (Artifact 109-010), an electroplated silver condiment shaker cap, possibly for dispensing salt or pepper, was preserved from *Westfield* (Figure 279). Silver was one of the first metals to be electroplated commercially, primarily for tableware. Electroplated silver objects were highly decorative and resistant to attack from fruit acids and other foodstuffs (Canning 1960:383). Few small personal artifacts belonging to *Westfield* are as diagnostic or important as the condiment shaker cap. Such a decorative item may have come from the Commodore's or officers' table. The discovery of the shaker cap was momentous and is a very good example of why x-raying is so important in archeological marine conservation. Weeks of x-raying *Westfield* concretions had yielded little more than a series of bolts, bleeds, and boiler bits. A large bolt, which appeared to have a small radio dense button towards the end, was visible on the x-ray. Further x-rays revealed the shaker cap, which confirmed suspicions that this was something significant.

In Donald Fennimore's American Silver and Pewter (2000:68), the author lists a Victorian electroplated cruet made in 1861 by the Meriden Britannia Company from Meriden, Connecticut. This example shown in Figure 280 has three free-swinging baskets which rotate a center axel, allowing the items in each basket to be easily reached. While the set from which the *Westfield* shaker cap came from may not have been as fanciful as this, the cap does match others in this set almost identically. The cap most likely came from a glass bottle similar to those shown on the bottom left of Figure 280.

Shipboard Tools

Tools provided for the vessels of the U.S. Navy varied by the size and type of ship, according to the Navy Department's specific allotment. When compared to the large varieties and quantities allotted, the tools recovered from *Westfield* represent a very small and poorly preserved portion of what was originally available.

Files

Files are made in a wide variety of sizes, shapes, and weights for multiple or specific tasks, and they are of great importance to all workers of metal. Files have to be strong and durable, and harder than the metal they are filing. The U.S. Navy Department issued files under three categories. For the engineer's department, between 18 and 36 files and 12 to 18 file handles may have been issued to *Westfield* for a two year period. For the carpenter, between 3 and 6 cross cut saw files, fine saw files, and 2-3 rat tail saw files, in addition to 6 to 15 handsaw files were issued. In a separate section, the carpentry department was issued between 4 and 10 flat bastard files, flat, fine files, half-round files, and half-round bastard files. Between two and four rat-tail, three-sided, and four-sided files were also issued (United States Navy Department 1865:25, 78 and 87). Three files were recovered from the wreckage of *Westfield*. Determining which department these files were allocated to, is impossible. However, this information clearly demonstrates that the files recovered from *Westfield* are only a small portion of the many files issued to a naval ship. The three files came from the same grid square on the site, 119. This grid square is located almost in the center of the wreck site and may indicate a central location for tool storage on the ship. Unfortunately, due to the wrecking event, assumptions of this nature, while suggestive, remain speculative.

All three of the files were recovered in very poor condition, and required molding and casting to preserve their shape and information (Figure 281). The original artifacts did not survive this process. Following conservation, one of the file casts was mostly complete (Artifact 119-054), and the results preserved a half-round epoxy file from the point to the upper portion of the tang or spike). The majority of the handle did not survive. Teeth were spaced 0.05 inches apart on the front and back face, and along the edges. The flat face contained angled, double-cut teeth, while the rounded face contained angled, single-cut teeth. The other two file casts (Artifacts 119-151 and 119-138) survived only as short fragments, both from the point end of the file, opposite of the tang or spike. These files contained angled, double-cut teeth, spaced 0.04 inches apart on both faces and along their edges.

Miscellaneous Tools

The remaining tools from *Westfield* fall into a category of miscellaneous types and uses. A hammer head (Artifact 132-385) was recovered near *Westfield*'s firebox (Figure 282). This places the hammer just south of the grid square in which the files were found, again offering the possibility that many of these tools originally came from the same area of the ship. The hammer contains a square shape that expanded into a rounded striking end. At the center, an elliptical hole once supported a wooden handle, of which two fragments survived. The U.S. Navy issued a variety of hammers to navy ships, including chipping hammers, hand hammers, riveting hammers, and assorted copper hammers (United States Navy Department 1865:26). The type of this particular example is difficult to identify due to the hammer’s poor preservation.

A well preserved weight (Artifact 121-084) from a counterpoise scale was recovered in grid square 121 (Figure 283). The cast iron artifact contains a cylindrical shape that tapers in a conical fashion towards the top, where the weight was originally hung by a hook. The bottom of the weight contains an indented circle, with a hole to the interior. At the time of manufacturing, this hole was filled with lead to give the object the desired weight amount. Completed, the weight would have hung from a scale, counterbalancing an object that was placed onto the scale to be weighed. A cross-sectional drawing based on x-radiography conducted on the artifact is shown in Figure 284. This

FIGURE 281. CONSERVED FILE TOOLS (ARTIFACT NO. 119-054, 119-151, AND 119-138)

FIGURE 282. WROUGHT IRON HAMMER HEAD TOOL (ARTIFACT NO. 132-385)

FIGURE 283. CAST IRON COUNTERPOISE WEIGHT (ARTIFACT NO. 121-084)

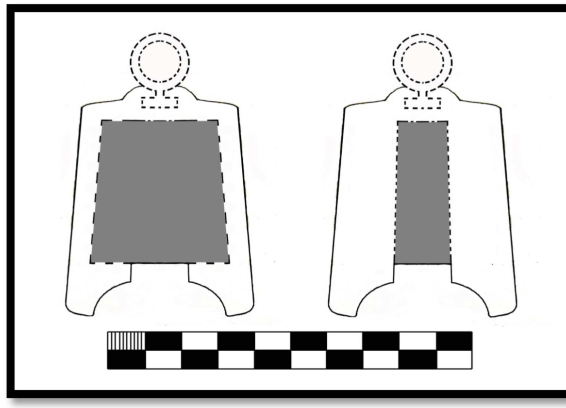

FIGURE 284. TWO POSSIBLE CROSS SECTONS OF COUNTERPOISE WEIGHT'S LEAD INTERIOR

FIGURE 285. THREADED BRASS LOOP FITTING (ARTIFACT NO. 121-137)

FIGURE 286. BRASS SOCKET TRAMMEL FROM NAVIGATIONAL BEAM COMPASS (ARTIFACT 118-023)

drawing displays how the lead appears in the interior. A second artifact that was also recovered in grid 121 (Artifact 121-137), may have been associated with the same counterpoise scale. The end of this cupreous fitting contains a loop, while the interior has threads that allowed the object to be screwed onto a larger object (Figure 285). Similar fittings can be seen in many 19th-century scales that utilized the loops or hooks as hanging points for the weights. Unfortunately, without more information, or more of the original object, a positive association with the weight cannot be confirmed.

A single brass socket or trammel (Artifact 118-023) survived from a navigational beam compass (Figure 286). Originally, there would have been two of these trammels that slid along a rod in order to widen or shorten the distance between them, when used on a navigational chart. To support the rod, two arms or extensions are hollowed out in the shape of a cylinder on either side of the object, creating a head. Based on this hollowed head, the original rod was also cylindrical and contained a diameter of approximately 0.21 inches. A small slit extends .89 inches from the top of the tool dividing the head into two sections. Piercing through this divided head, a small broken screw was once used to tighten, or secure the trammel at the desired location on the rod. The bottom of the artifact contains a tab that appears to have inserted into another object. Following the example of modern trammels, the broken screw likely ended in a small wheel or thumb screw that could be turned with two fingers, and the tab on the bottom accommodated different end caps that could contain ink, pencil graphite, or needle tips for numerous navigational needs (Figure 287).

Two brass tourniquet buckles (Artifacts 118-024 and 133-111) recovered from the wreck site serve as large reminders that *Westfield* and her crew faced constant danger (Figure 288). Like today, tourniquets were used in the Civil War to stem blood flow in limbs when personnel were injured or about to undergo an amputation. Only certain brass portions of *Westfield*'s tourniquets survived. There are several mounting holes on both buckles where pieces have broken away. Originally, the tourniquets contained a rolling arm with prongs that bit into a cloth strap to apply pressure on a limb (Figure 289). Small rust deposits on the mounting holes suggest that the original securing pins were iron and did not survive. Without the pins, the rolling arms became detached on both artifacts, as did one of the cylindrical cloth guides on Artifact 118-024.

Unidentified Tools

As with most excavated shipwreck sites, some artifacts remain a mystery to archeologists. These artifacts cannot be easily identified due to their damaged condition or simply because a present-day version or equivalent has not been discovered. Identifying artifacts from *Westfield* proved to be a challenge due to the violent nature in which the vessel was destroyed. Artifacts often appeared twisted and unrecognizable. Other times, an individual artifact represented only a small part of a much larger device or assembly. The following artifacts fall into these categories.

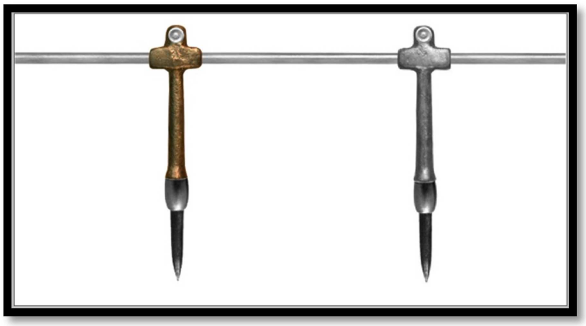

FIGURE 287. THEORETICAL RECONSTRUCTION OF NAVIGATIONAL BEAM COMPASS

FIGURE 288. BRASS TOURNIQUET BUCKLES (ARTIFACT NO. 118-024 AND 133-111)

FIGURE 289. INTACT TOURNIQUET BUCKLE FROM TERRESTRIAL CIVIL WAR SITE (IMAGE COURTESY OF ALEX PECK MEDICAL ANTQUES)

FIGURE 290. UNIDENTIFIED BRASS ARTIFACT - POSSIBLY A GUN SIGHT (ARTIFACT 133-109)

FIGURE 291. SMALL BRASS SPRING (ARTIFACT NO. 19.6)

FIGURE 292. SMALL BRASS TAB (ARTIFACT NO. 136-001.6)

FIGURE 293. SMALL COPPER PUNCH TOOL (ARTIFACT NO. 118-020)

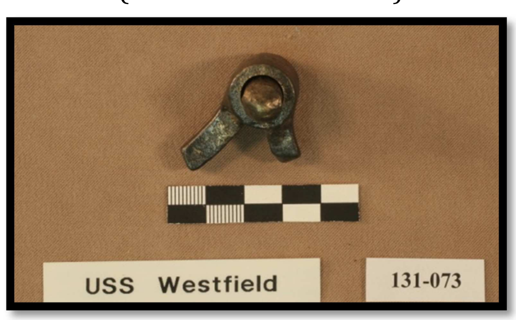

FIGURE 294. POSSIBLE FRAGMENT FROM NAVIGATIONAL SEXTANT (ARTIFACT NO. 131-073)

A larger brass artifact is believed by conservators to be a gun sight from a large piece of ordnance (Artifact 133-109). The object has a rectangular lower body, which on top of the longest sides, slopes gracefully upwards into a sight-like ridge (Figure 290). The artifact contains four broken mounting points that appear to contain screws that snapped off inside the object. Without understanding to what the artifact mounted, the use of the object is still considered unidentified.

Excavations recovered five small cupreous springs of equal coil size diameter (Figure 291). The lengths of these artifacts varied between one to two centimeters. The springs all appear to have been clipped to their respective lengths rather than undergoing breakage during site formation processes. How these artifacts were used on *Westfield* is not clear. Conservators found two of the springs within the same concretion, while the remaining three contained proveniences of no apparent pattern. All of the artifacts were found within concretions that contained an assortment of miscellaneous bolts, fasteners and metal fragments. These accompanying artifacts do not appear to have shared any correlation to the springs' original use.

A small brass tab (Artifact 136-001.2) was found concreted to a fist-sized chunk of coal (Figure 292). The artifact resembles a finger lever that snapped off from a larger mechanical device. Since coal was found concreted to most artifacts due to *Westfield*'s explosion, the artifact cannot be readily associated with something mechanical in the boiler or engine room. How the object was used or from what type of device it came is unclear. The item may have been personal or from a larger piece of shipboard equipment.

Over 1500 copper tack fasteners were recovered from *Westfield*. These fasteners vary in size since they were all handmade. One supposed tack however (Artifact 118-020), is considerably larger than the rest and does not appear to have contained a head (Figure 293). In general shape, the object is conical. The head may have broken off and the object became weathered and slightly rounded, erasing any evidence. Conservators disagree on whether or not this object was something else, such as a copper punch tool. Rather than weathering and erosion, the rounded head may have been caused by another object striking the head. Additionally, a slight bend at the narrowest point suggests that the object is slightly distorted. This distortion could have been caused due to the soft nature of the metal being used over a longer period of time.

A rather unique shaped artifact led to much speculation among conservators (Artifact 131-073). The artifact contains two dual arms that radiate out from a reinforced open center (Figure 294). Inside the opening, a heavy pin was hammered on one side to prevent slipping, but is now broken. The reinforced center and the large size of the pin suggest the artifact originally came from a much larger object. Based on the curved shape of the arms, conservators believe the artifact came from a navigational sextant, and that the heavy pin once supported a pivoting telescope. Unfortunately, without more of the object, this theory cannot be confirmed.

During the conservation of one of *Westfield*'s fire grates, a small wooden dowel-like object was recovered from within the concretion (Artifact 132-001.93.1). The original use of the object is not clear. One of the ends contains two carved out sections that resemble holding points as though for an index finger and thumb (Figure 295). Conservators have theorized that the artifact could have been used as a kitchen stirring tool or a pestle from a grinding bowl.

One small brass artifact (131-075) resembles a tag that might have hung or possibly rotated as a fitting on a larger device. With the exception of a heavily weathered ring at one corner, this artifact is triangular with angles measuring 45, 45, and 90 degrees (Figure 296). Opposite of the ring, between the upper 90 degree and lower 45 degree angles, the in-between edge has been intentionally sharpened for an unknown purpose. All other edges are rounded.

Three artifacts (120-271, 125-062, and 128-064), which all are related in design, still have not been identified (Figure 297). The artifacts are made of brass and reinforced with ridges to prevent bending. Only Artifact 125-062 appears to be complete. The other two artifacts have snapped approximately midway through their original length. Artifact 128-064 contains a button at the end that once clipped onto an unknown object. These objects may have been used in a larger common device.

Horizontal Integrity

The relative paucity of artifacts remaining at the site, combined with the effects of salvage, demolition, and erosion, has presented some challenges to interpreting their distribution. Before distribution could be addressed it was necessary to determine, as accurately as possible, where the hull was previously situated and to distinguish the bow from the stern. A simplified hull plan of *Westfield* (see figures 298-304) was created for the purpose of overlaying on the site in the position and orientation believed most likely to have been where the ship came to rest. The hull plan was created by altering the plan view drawing of *Clifton* by Daniel Nestell (see Figure 43) so that it matches the proportions of the measured sketch of *Westfield* in the collection of the Memphis Public Library (see Figure 3). The only internal details included on the plan are the positions of the engineering section, indicated by a narrow rectangle at the center of the ship, and the smokestack, indicated by a circle at the bow end of the engineering section. The intent was to allow artifact distributions to be interpreted in the context of their positions within the hull, as if it were still there.

Positions of the Dahlgren cannon and the firebox (Figure 298), combined with historic accounts of the event, indicate that *Westfield* was steaming stern first against an ebb tide when the ship grounded. The final resting position of the hull was surmised largely based on the Dahlgren and firebox positions. The recovered Dahlgren, because of its tremendous weight, was assumed to lie

FIGURE 295. SMALL WOODEN DOWEL POSSIBLY USED AS PESTLE TOOL

FIGURE 296. SMALL BRASS TRIANGULAR TAG (ARTIFACT NO. 131-075)

FIGURE 297. UNIDENTIFIED BRASS TABS (ARTIFACT NO. 120-271, 125-062, AND 128-064)

very close its original position in the hull, and there is strong historic evidence that both Dahlgrens were on the stern when the ship ran aground. The firebox is presumed to have not moved far from its original position, because at least 75 percent of the fire grates remained articulated in their original positions within the box, and they were held in place only by gravity. The smokestack would have been centered between the two fireboxes. Since we can't be sure which firebox remained on the site after 1906, the smokestack was presumed to lie directly over the remaining firebox. If the firebox, in fact, has not moved, then the smokestack should be correctly positioned to within plus or minus about 8 ft.

The distance between the Dahlgren and the firebox is about the same as between the smokestack and the aft wall of the cabin on the Memphis drawing (Figure 3), and the Dahlgren is situated on the southern margin of the visible debris field. These two facts suggest that the Dahlgren recovered

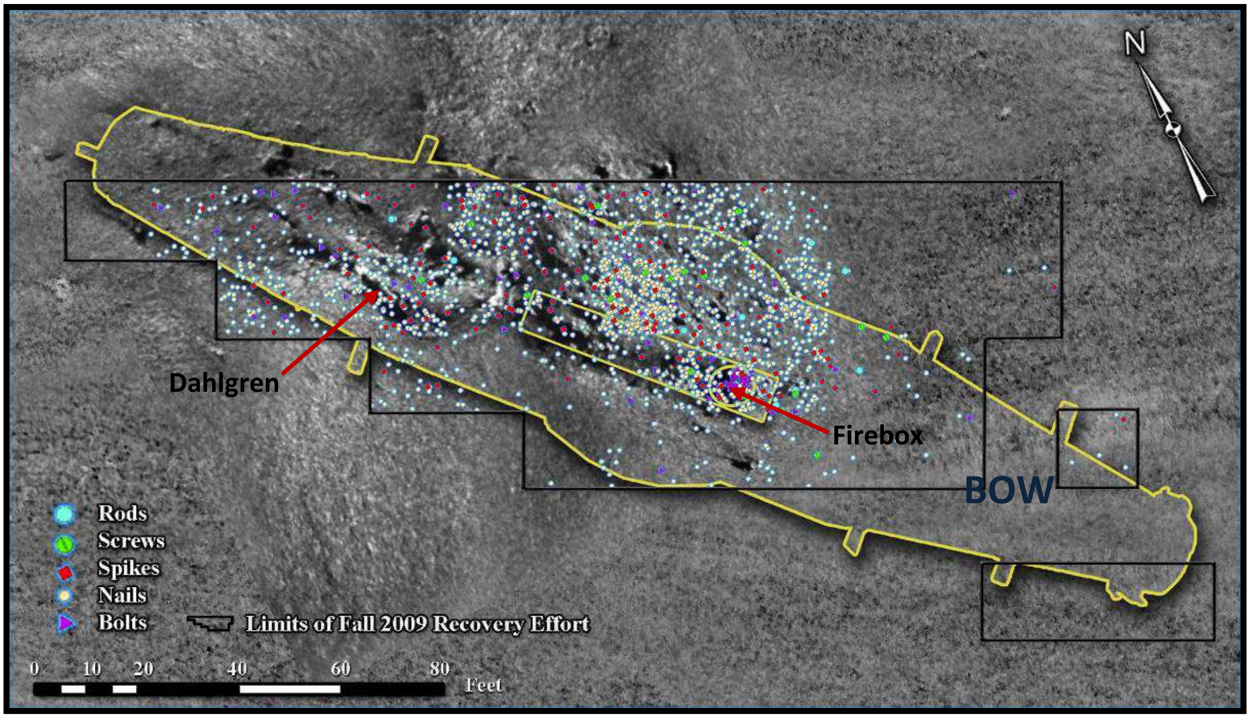

FIGURE 298. DISTRIBUTION OF FASTENERS (FIGURE BY SARA LAURENCE AND AMY BORGENS)

from the site was situated at the starboard broadside gun port nearest the aft wall of the cabin when the ship burned. The orientation of the hull overlay in figures 298-304, relying on the firebox as a pivot point, is based on the supposition that the Dahlgren should be positioned near the starboard side of the hull. As a result of this placement, most of the visible debris field would fall within the stern and machine-room areas of the hull. The hull overlay is only intended as an approximation. The precise former location of the hull cannot be known.

Distribution maps were created for several artifact groups based on the tightest provenience available for each. Some artifacts, for example, have very specific position data, like those collected by divers. Positions of the artifacts collected by the electromagnet and the clamshell are accurate to an area the size of the collection device plus or minus the accuracy of the underwater positioning system (about 3 ft). Positions shown on the distribution maps below have been randomized according to the dimensions of the device used to collect each artifact, rather than plotting them all at the central position recorded by the positioning system. This was necessary, so that multiple artifacts collected by a single clamshell grab, for example, would not all appear stacked at the central position as a single symbol on the map. The locations of artifacts recovered while screening the sediment have been randomized within the grid unit where they were collected, since their locations are only known to that level of accuracy.

The orientation of the *Westfield* outline on each distribution map is meant to approximate the position of the hull as it would have been when the ship ran aground. The intent is to provide a rough frame of reference for comparing and interpreting the distributions of various artifact categories. As explained above and in Figure 298, the smokestack (circle) in the plan view was placed directly over the firebox on the sonar image, and the starboard side of the hull (southern side) was placed near the Dahlgren cannon, such that most of the visible debris field aligns with the central and aft portions of the hull outline. The bow end of the ship is on the right hand side of each distribution map and is completely outside of the visible debris field.

Analysis of the artifact distributions suggests that several artifact groups, including fasteners, engine room artifacts, and munitions, have generally retained horizontal integrity. In other words, they appear where one would expect them to relative to the theorized hull position. Fastener concentration is most dense where the hull disintegrated in place, most of which was gone by 1906 when demolition occurred on the site. Metallic artifacts associated with the engineering section of the ship, including engine and boiler parts, are closely associated with the firebox and the central portion of the theorized hull location. Munitions tended to be concentrated aft of the engine room area.

Positions of larger heavy artifacts appear closer to their original lateral positions within the hull. Boiler components, with the exception of the intact firebox, seem to have dispersed more broadly than other small dense artifacts, such as munitions. This is consistent with what little is known of demolition at the site in 1906, which seems to have targeted the engine and boilers for removal. Also the stated purpose of the 1906 demolition was clearance of a hazard to navigation, so one would expect all or parts of large heavy objects to be more widely and randomly dispersed than had they been scattered by nature following the initial vessel explosion and fire. In fact, there is some evidence to suggest that efforts by the snag boat to drag one or both boilers off site resulted in a trail of boiler parts across the site from the boilers' original positions to where the snag boat was presumably anchored up current (in this case northwest of the boilers). This theory also could account for the apparent rotation of the remaining firebox, since the boiler drums originally would have been located southeast of their respective fireboxes. The act of dragging a boiler drum toward the northwest would have rotated the firebox until eventually one boiler, by 1906 heavily corroded, broke free from its firebox, leaving it for archeologists to discover.

Many other artifacts related to the engine room, and especially artifacts from lower elevations of the engine assembly, are concentrated within the central portion of the theorized hull position (southeastern portion of the debris field), around and north of the firebox in an area that would have contained the engine room (see figures 299–301). Munitions are concentrated northwest (aft) of the engine room area in the direction, at least, of the aft shell locker (see figures 302 and 303). These distinct concentrations indicate that the site retained some horizontal patterns consistent with expectations for the site if it were intact.

Fastener Distribution

The horizontal distribution of fasteners (Figure 298) clearly demonstrates that much of the wood hull in the stern and mid-ships areas decayed in place at this very location until the fasteners eventually fell out and became mixed with the sediments. The site clearly represents the former hull location rather than an assemblage of artifacts redeposited here by either destruction or demolition. Sheathing nails and other fasteners could not have become so concentrated within the main debris field of larger artifacts in any other way. Furthermore the fastener distribution falls off rapidly east of the firebox, confirming the destructive force of the forward magazine explosion and the complete separation of the remaining bow area from the main body of the wreck as reported by Confederate salvers.

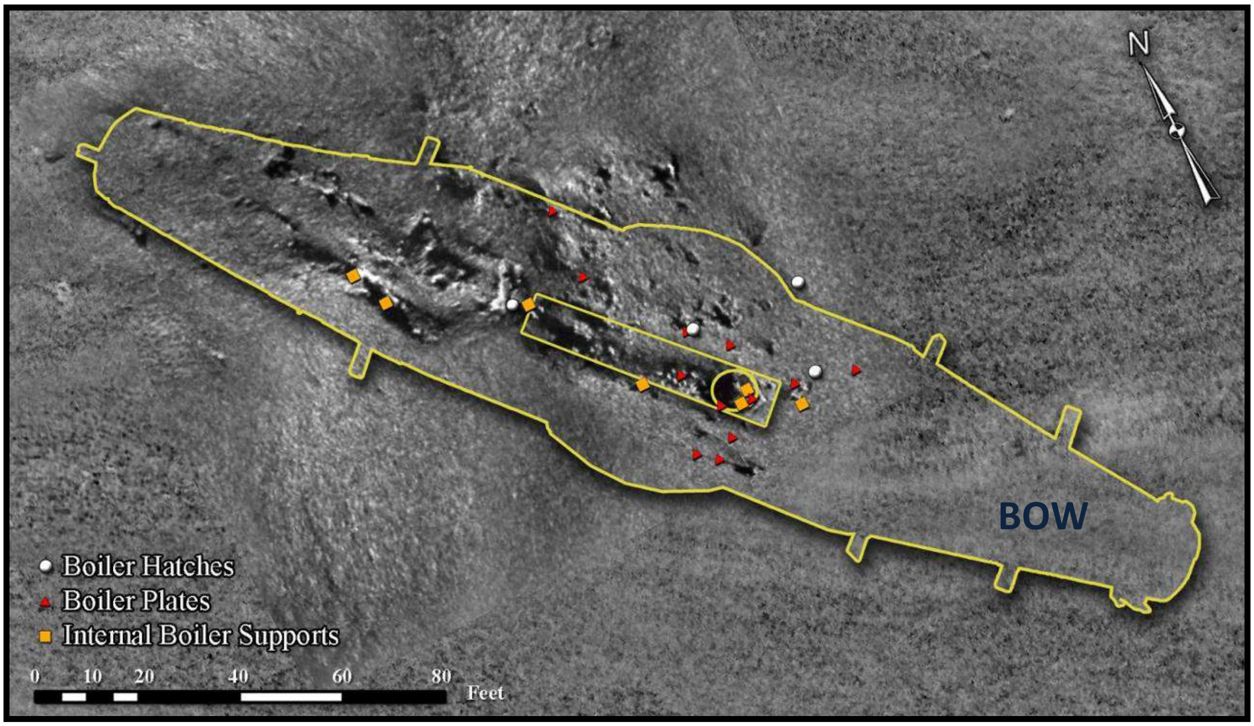

FIGURE 299. DISTRIBUTION OF BOILER HATCHES, BOILERPLATE, AND INTERNAL SUPPORTS
(FIGURE BY SARA LAURENCE AND AMY BORGENS)

Steam Machinery Distribution

Figures 299–301 illustrate the locations of artifacts that are related to the machine area of the ship, including boiler hatches and plates, internal boiler supports (excluding staybolts), railroad iron used as substitute fire grates, coal, cast iron floor plates, and brick. For most of these groups, the artifacts are generally concentrated in the area of the boilers (near the smokestack in the figures) at the southeast end of the visible artifact debris field. One exception is the brick, which is fragmented

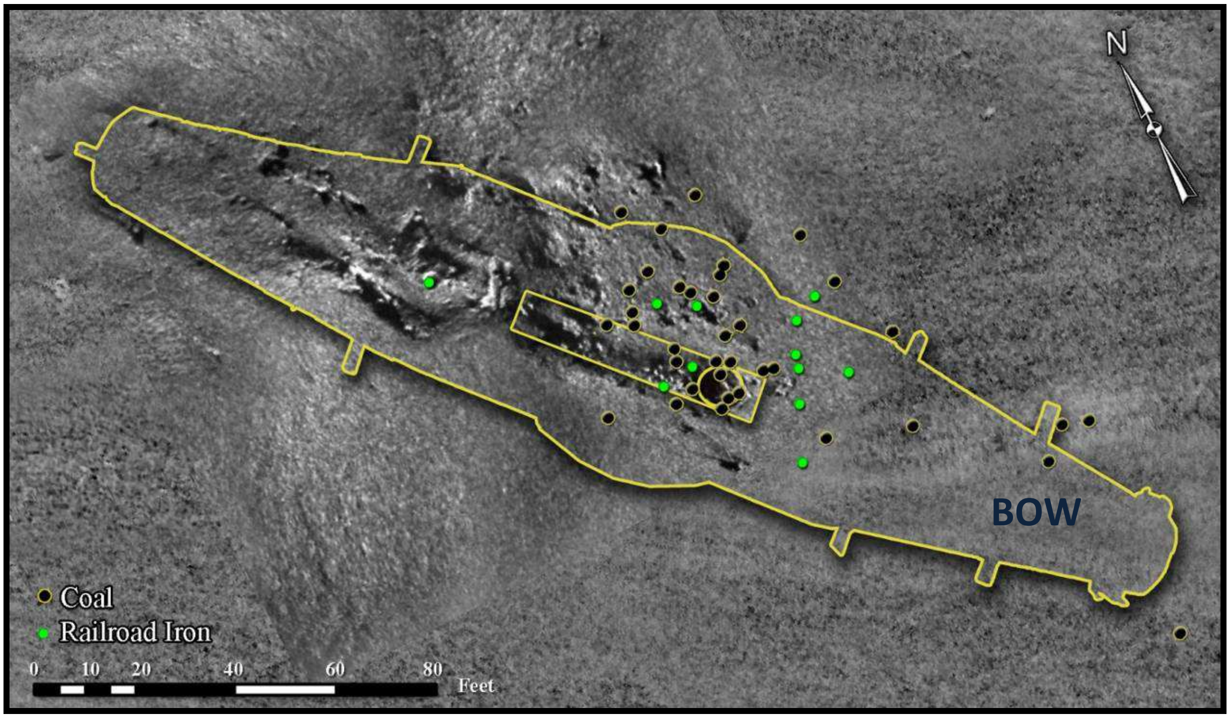

FIGURE 300. DISTRIBUTION OF COAL AND RAILROAD IRON (FIGURE BY SARA LAURENCE AND AMY BORGENS)

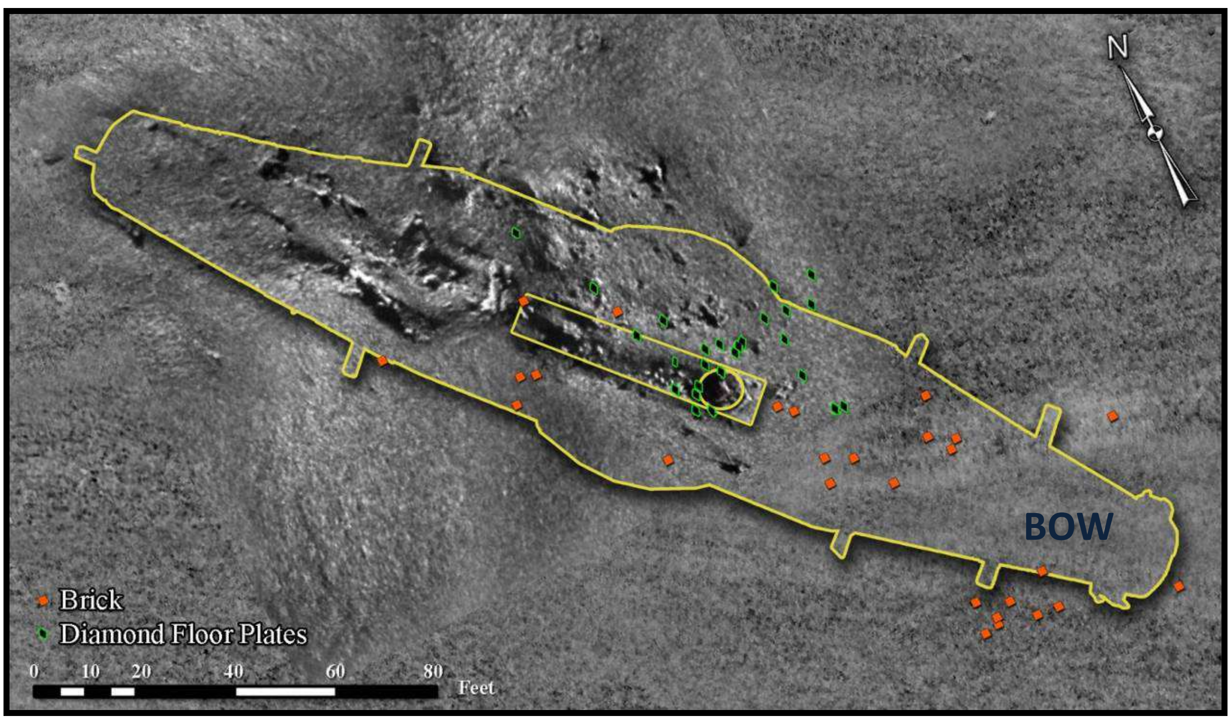

FIGURE 301. DISTRIBUTION OF BRICK AND FLOOR PLATES (FIGURE BY SARA LAURENCE AND AMY BORGENS)

and infrequently larger than 2 to 3 inches. The brick might have been associated with the engine room; however, its distribution across the site is primarily concentrated in the bow area (Figure 301).

Ammunition Distribution

Most of the ammunition, in the form of shells, fuses, canister shot, and small round shot, is congregated in the aft half of the wreck site (Figure 302). Most shells appear to have been moved a bit from their original positions, especially fused 8-inch shells that would have been stacked on the bow deck when the magazine exploded. It's possible that others were shifted both in fore and aft directions during 1906 demolition operations when heavy machinery components were believed to have been dragged across the seafloor. The canisters were sparsely scattered across the aft end of the site, though small solid shot was primarily collected in the grids encompassing the cannon and from areas just aft and to port of the "engine room" (Figure 303). Buckles, both for cartridge boxes and belts, were also located aft of the engine room (Figure 304). The high density of munition artifacts in this general area (other than fused shells, which would have been stacked on deck) likely relates to the location of the aft shell locker.

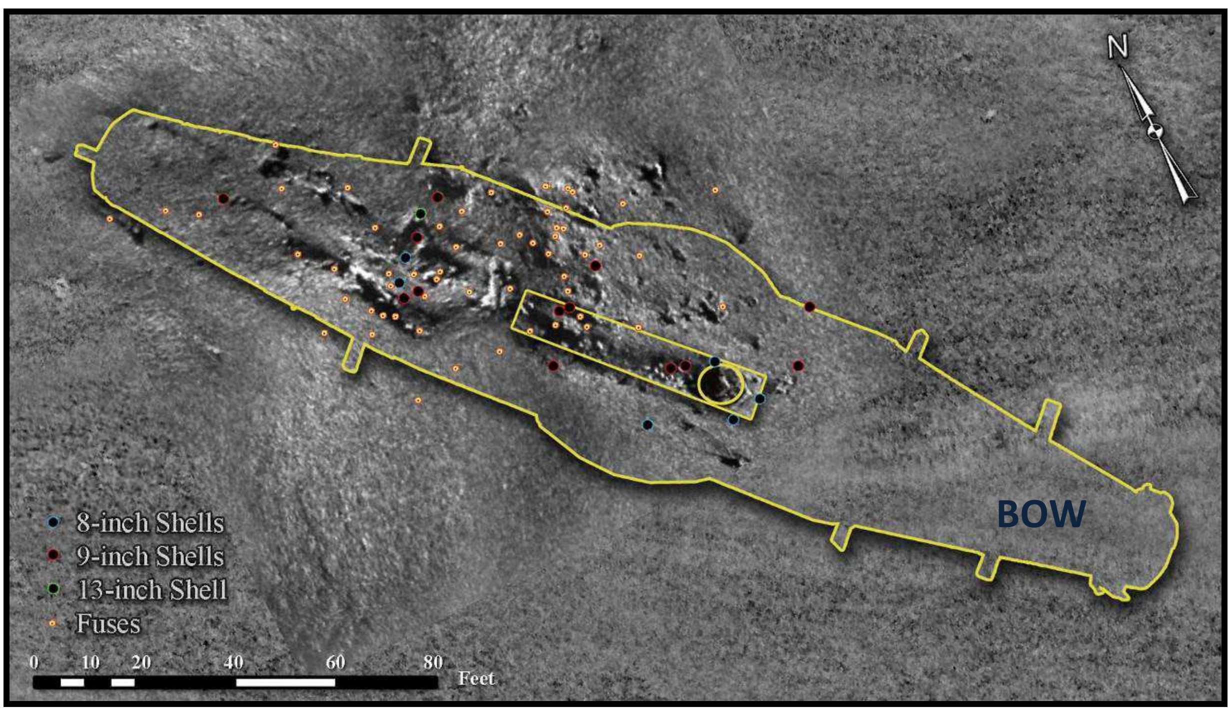

FIGURE 302. DISTRIBUTION OF SHELLS AND FUSES (IMAGE BY SARA LAURENCE AND AMY BORGENS)

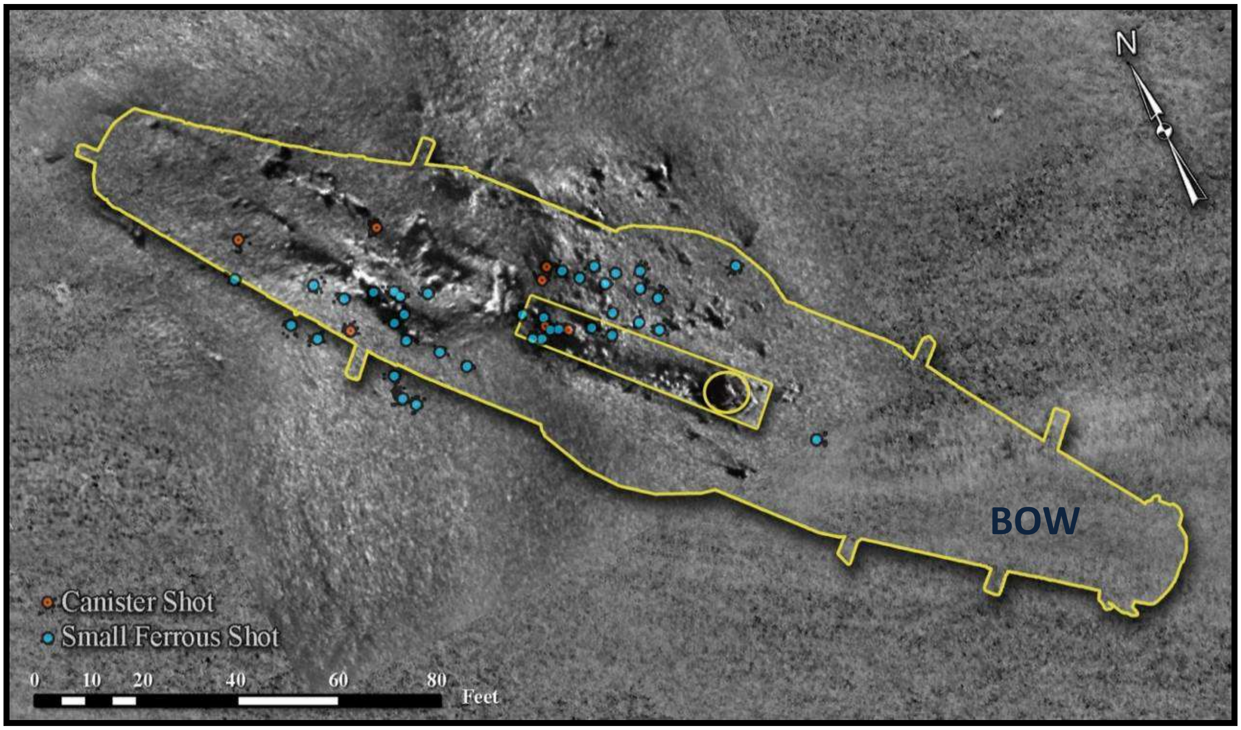

Figure 303. Distribution of Canister Shot and Small Solid Shot (image by Sara Laurence and Amy Borgens)

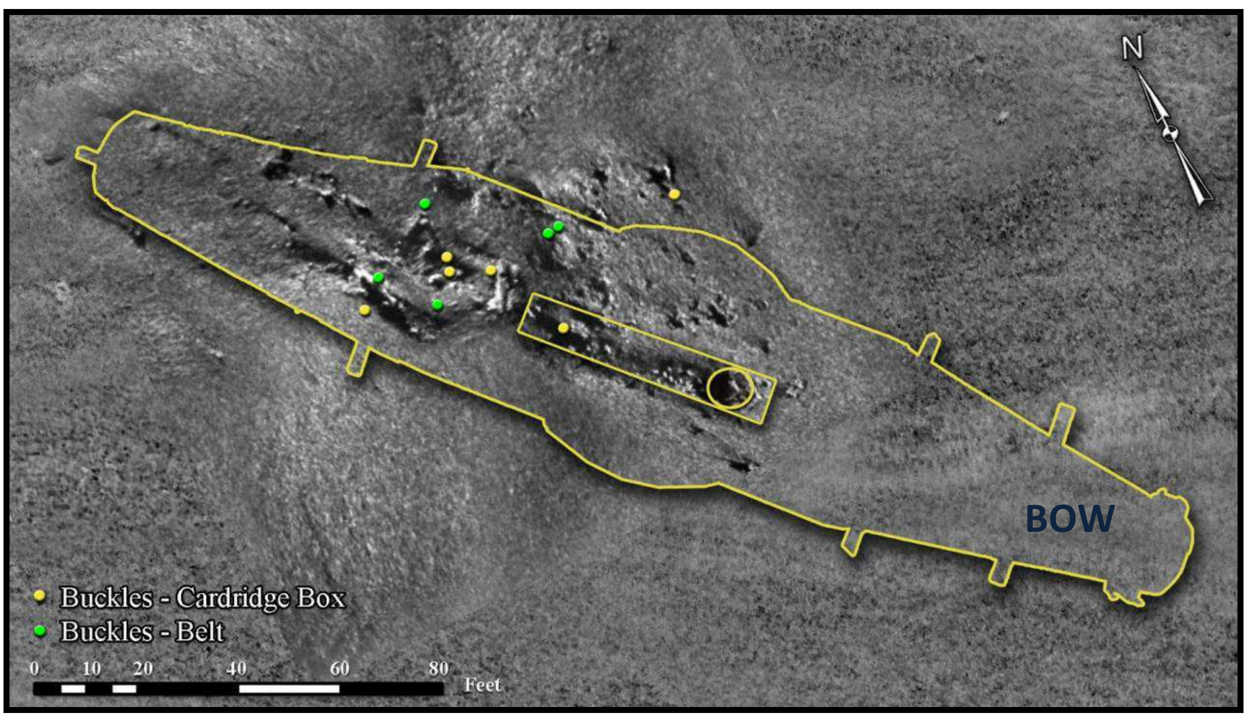

Figure 304. Distribution of Buckles (image by Sara Laurence and Amy Borgens)

8

NATIONAL REGISTER ELIGIBILITY

Atkins evaluated *Westfield* for NRHP eligibility in 2006 (see Chapter 4) and concluded at the time, prior to artifact recovery, that the site demonstrated sufficient historic significance, historic context, and historic integrity to be eligible for the NRHP. The USACE determined that *Westfield* is eligible for the NRHP and requested concurrence of the Texas SHPO in 2006. Both the SHPO and NHHC concurred in 2007 that *Westfield* is eligible for the NRHP under criteria A, B and D (Appendix C-4). Most of the following arguments for eligibility were made by Atkins in 2006 and served as the basis for the site's determination of eligibility. Insights subsequently learned from archeological recovery and conservation suggest that the site might also be eligible for the NRHP under Criterion C.

The National Park Service published a bulletin (National Park Service 1990, revised in 1997) that defines the criteria for evaluating and nominating historic structures and objects for the NRHP. A secondary publication (National Park Service 1992) elucidates how these criteria apply to historic vessels and shipwreck sites. In order to qualify for the National Register, a historic shipwreck site must have both *significance* and *integrity*.

SIGNIFICANCE CRITERION

Historic significance relates to a vessel's importance in American history, architecture, archeology, or culture (its historic context) and includes four criteria. It covers topics such as the vessel's association with key events and persons; the existence of diagnostic features for identification (specific or general) of the vessel; and the rarity of the vessel type. A vessel must satisfy one or more of the following criteria in order to be considered eligible. A vessel must:

A. be associated with events that have made a significant contribution to the broad patterns of our history; or

B. be associated with the lives of persons significant in our past; or

C. embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic value, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

D. have yielded, or may be likely to yield, information important in prehistory or history. (National Park Service 1992:5–6)

The National Park Service defines ***historic context*** as "information about historic trends and properties grouped by an important theme in the prehistory or history of a community, State, or the nation during a particular period of time" (National Park Service 1997a:4). Historic context provides the link between a shipwreck and unique, representative, and/or pivotal historic trends. Historic context should address the significance of a wreck at a general level of its vessel class or function, for example, and also at the specific level of the particular vessel's role in historic events. ***Historic integrity*** ". . . is the ability of a property to convey its significance" (National Park Service 1997b:44).

Historic Context

Westfield is emblematic of a period in the early history of the Staten Island Ferry, an organization that has continued to endure and prosper in an industry that has otherwise witnessed decline. Its significance in this regard is further reinforced by its connection to prominent artisans and businessmen of the period. The construction and later conversion of the vessel was affected by Jeremiah Simonson and Jacob Westervelt, two nationally recognized New York shipbuilders who produced vessels for both private and government interests. Cornelius Vanderbilt and Charles Morgan, associated with *Westfield*, respectively, through ownership and construction, are both recognized as major entrepreneurs of the transportation industry in the nineteenth century.

Westfield was one of only three New York ferryboats, also including *Clifton* and *John P. Jackson*, employed as part of the West Gulf Blockading Squadron (Minick 1962:435). These New York ferryboats, along with a small number of other shallow-draft steamboats, were the work horses of Commander David Porter's Mortar Flotilla, which was attached to Farragut's larger Gulf Blockading Squadron. The success of Union naval bombardments at New Orleans and Vicksburg arguably hinged on the ability of these few vessels to pull the "bomb ships" of the entire mortar flotilla and the deeper-draft sailing ships of Farragut's fighting fleet over the Mississippi River Bar. Once all the ships had been pulled safely across the bar, *Westfield* and its companions towed the entire flotilla of mortar ships into the precise positions required for them to effectively reach their desired targets. Following its involvement in the Mississippi River campaign, *Westfield* was transferred to the Texas Coast where it served as Commander W.B. Renshaw's flagship. In that capacity, it played a role in the Union occupation of Galveston and the shelling of Port Lavaca.

Westfield ran aground on New Year's Day, 1863, during the Confederate recapture of Galveston. The grounding of *Westfield* was a pivotal moment in the Confederate battle to retake Galveston. Two events might have contributed to the grounding: the burning of the Bolivar Point Lighthouse and the transfer of *Westfield*'s pilot to *Mary Boardman* on the afternoon prior to the battle. Had either event not occurred, *Westfield* might not have run aground in the night when the Confederate cottonclads were detected coming down the bay. Had *Westfield* not run aground, it might have intercepted the Confederate steamers before they reached *Harriet Lane* and the city of Galveston. *Westfield*'s crew had sighted the cottonclads by at least 2 A.M. and ran aground soon after initiating pursuit, at which time Renshaw sent a boat over to the *Mary Boardman* requesting the return of their pilot (*New York Times* 1863). According to Scharf (1887:505–506), the cottonclads were waiting “twelve miles off, at Half Moon Shoals” for signals from their land forces before they attacked, but the troops took longer than anticipated to maneuver into position on Galveston Island. Fighting did not break out until sometime around 4:00 A.M., so *Westfield* should have had ample time to intercept those boats before they reached *Harriet Lane*. Not only was *Westfield* unavailable to assist with the defense of Galveston, but when Captain Renshaw saw *Harriet Lane*’s signal that Galveston was under attack, he immediately ordered *Clifton* to come to the aid of *Westfield*. By the time *Clifton* returned to Galveston Channel, the battle had been decided and *Harriet Lane* had been captured. Unable to free his ship, Captain Renshaw ordered it blown up to prevent its capture, inadvertently killing him and at least 12 others in the process.

The recapture of Galveston ultimately did not affect the outcome of the Civil War; however, the city of Galveston played an important role on the Gulf Coast during the war. It was the finest deepwater port between New Orleans and Vera Cruz during this period. Galveston was a major exporter of cotton, sugar, and molasses and was a potential source of cotton for textile mills in New England, which might have been an impetus for the Union invasion (Cotham 1998:3). For the Union, the loss of Galveston not only took away a potential source of cotton but also increased the difficulty and risk for the blockading fleet to operate in the region, since it no longer commanded a safe anchorage at Galveston. For the Confederacy, Galveston exports were a vital source of profit and funding for the war effort.

Historic Significance

USS *Westfield* is believed to be historically significant under NRHP criteria A, B, C and D. The historic significance of *Westfield* relevant to NRHP criteria A and B (association with significant events and significant lives) is readily apparent from the summary of the ship’s historic context and from the broader history section of this report (see Chapter 2) and requires no further elaboration here. A case also can be made for significance under Criterion C (distinctive characteristics of a type, period, or method of construction). Many artifacts recovered from *Westfield* contribute to an understanding of walking beam engines and return flue boilers from the mid-19th century. The evidence for Criterion C significance rests primarily on museum and drawing reconstructions of engineering components based on machinery fragments recovered from the site. These reconstructions are summarized in the analysis of engine and boiler artifacts in an earlier chapter. More detailed reconstructions are the subject of a pending doctoral dissertation at Texas A&M University by one of the authors, Justin Parkoff.

Significance under Criterion D (yielding information important in history) was based on the fact that *Westfield* represents an opportunity to study the transition from civilian steamboat to naval gunboat. The U.S. Navy refitted *Westfield* to serve its needs as an armored gunboat. The conversion of ferryboats to military use is poorly documented. In fact, most illustrations of *Westfield,* including contemporary accounts in popular news outlets, are suspected to substantially misrepresent its appearance. Such illustrations tend to depict *Westfield* as a Staten Island ferry interjected into a battle scene, rather than as a thoughtfully refitted military gunboat. Relatively little historic documentation is known to exist that describes the military conversion of these ferryboats. The wreck of *Westfield* therefore presents an opportunity to study an archeological example from the Civil War of the transition from civilian steamer to naval gunboat, as described in Kibler et al.'s (1996:110–111) preservation plan created for the USACE.

Westfield was one of only 20 converted New York ferryboats to serve in the U.S. Navy during the Civil War. An extensive history of this class of vessels was published by Rachel Minick (1962) in *The New York Historical Society Quarterly*. She succinctly summarized the significance of these boats to the northern war effort.

> Of what consequence was this tiny fleet of ex-ferryboats? After all, 1,065 different vessels served in the Navy at one time or another, for longer or shorter periods, during the Civil War. . . . Of these, the 20 ferryboats converted into gunboats constituted comparatively an insignificant part. They played no key roles in the memorable battles. But their special adaptability for the necessary patrolling of inland waters and for other subordinate tasks which larger and more formidable craft could not perform rendered them more useful than their size and number might indicate. The blockading fleet commanders from beginning to end sent hundreds of calls to the Navy Department for more light-draft steamers as essential to the success of their undertakings. When one considers that these small boats, built for transporting civilian commuters and produce across peaceful rivers, took boldly to the high seas, braving the violence of open oceans to reach distant ports, and there . . . played their destined parts as fighting ships along with the grandest frigates and toughest ironclads, it seems worthwhile to tell their untold story in recognition of the unique and by no means insignificant contribution which New York City made through them to the naval history of the Civil War. (Minick 1962:436)

Westfield is believed to be a rare representative of a specific vessel type: New York ferryboats converted for military use. No comparable vessels have come to light, either floating or in the archeological record, that positively preserve elements of their military conversions. Two other Staten Island ferryboat gunboats are known to survive; *Clifton* lies beneath a marsh at Sabine Pass, Texas, and a portion of *Southfield* is in the Roanoke River (Hoyt et al. 1994; Spirek 1993). At least half of the hull of *Southfield* has been preserved and documented. Though this vessel was a Staten Island ferry, it was constructed in 1856 by a different shipbuilder, John Englis (Spirek 1993:46).

The historic context of *Clifton* is very similar to that of *Westfield*. The two vessels were almost identical, constructed at the same time and by the same builder—potentially as "sister ships." Both vessels saw nearly identical duty up to the time of the Battle of Galveston, after which their histories diverged. *Clifton* continued to serve in the Union Navy until its capture at the Battle of

Sabine Pass and then was converted to use as a Confederate blockade-runner. It eventually ran aground at Sabine Pass where it was burned to prevent capture by the Union Navy.

We can surmise from probing investigations (Hoyt et al. 1994) that substantial portions of *Clifton*'s lower hull are preserved; however, no archeological excavation has been done on *Clifton* to date. While there may be many similarities between these vessels, one cannot assume that the archeological remains of one can substitute for those of the others. We do not know whether *Clifton* retained significant elements of its naval conversion once it had been captured by the Confederacy. Nor do we have a clear idea of what was removed from the vessel during its salvage. Although we have fewer physical remains of *Westfield,* we know a good deal more about *Westfield* at the time it was wrecked because it was in military use when it was destroyed.

Significance under Criterion D (yielding information important in history) is further justified based on of how the artifact distribution has informed our knowledge of *Westfield's* destruction and subsequent preservation. Table 4 in Chapter 2 summarizes many, often contradictory, published accounts of the Battle of Galveston. Archeology has corroborated the accounts of the closest eyewitnesses who were on *Mary Boardman* at the time, while refuting many incorrect statements of others less close to the event. The position of the remaining Dahlgren and the firebox, two features that could not have moved substantially from their original positions, provide reasonable reference points for overlaying a scale drawing of the ship's deck plan on the site. Knowing the position and orientation of the ship when it was destroyed has allowed an assessment of how far various artifact classes have moved horizontally. Such an assessment is important to future archeological investigations of shipwrecks that seemingly have been disturbed beyond hope of recovering significant information.

Integrity

Integrity is comprised of seven key aspects or qualities: location, design, setting, materials, workmanship, feeling, and association. For historic vessels these qualities address such topics as the proximity of the vessel to its area of use, the current setting (waterborne or land borne), design changes, replacement of structural components for repair, and whether it still evokes an aesthetic or historic sense of the past. These qualities are primarily applicable to four of the five types of historic vessels that may be considered eligible for the NRHP: floating historic vessels, dry-berthed historic vessels, small craft (floating or display), and hulks (abandoned or laid-up craft on land). The fifth type of vessel that can be considered eligible, shipwrecks, in most cases will not qualify under all seven aspects of physical integrity as required for nomination. Documentation of these sites is addressed separately in a section where it is emphasized that a shipwreck does not have to retain extant hull/construction features or maintain integrity as defined above to be considered eligible for listing in the NRHP (National Park Service 1992:14–20).

Shipwreck integrity is not limited to the survival of intact hulls. Integrity may also extend to a structure that exists in sufficient form to address architectural, technological, and other concerns. It may also be applied to scattered or broken remains, if data can be generated that will permit the development of anthropological inferences and/or the formulation of testable research questions. Artifacts, soil stains, or casts of material remains (resulting from encrustation and later deterioration of the artifact) may also contribute to integrity.

Intensive salvage, looting, or the collection of artifacts, does not necessarily compromise integrity. Instead, these activities may change either the focus of research or the National Register criteria to be applied. In the event of salvage, looting, or vandalism, the site's remaining research value must be demonstrated. If artifact association with the site can be authenticated, collections for the site may be used to aid in establishing the research potential of the shipwreck.

Isolated structural components, or other widely scattered remains on a coast or seabed, may also possess integrity. Sufficient diagnostic attributes must be present to permit identification of the vessel type and historic context or discussion of significant construction details, marine engineering, or other technological aspects; or discussion of the spatial relationship with similar significant remains; and a discussion of eligibility or significance (National Park Service 1992:17).

Horizontal integrity is an invaluable aid for deducing the physical characteristics of a shipwreck, such as size, orientation, and organization of a vessel; however, as described above, the concept of integrity ". . . may also be applied to scattered or broken remains, if data can be generated that will permit the development of anthropological inferences and/or the formulation of testable research questions" (National Park Service 1992:17). Likewise, "Intensive salvage . . . does not necessarily compromise integrity. Instead, these activities may change either the focus of research or the National Register criteria to be applied" (National Park Service 1992:17).

Four particular events initially called into question the integrity of the USS *Westfield* artifact assemblage: 1) Explosion of the forward magazine severely damaged the bow section of the vessel and, in fact, broke the ship into two sections. The bow was reportedly 60 yards away from the main hull when it was salvaged; 2) Confederate salvage of the site in 1863 removed a substantial quantity of reusable material from the site; 3) Demolition of the vessel as a hazard to navigation in 1906 involved the use of explosives and a snag boat to remove and/or lower shallow portions of the site; and 4) Substantial vertical displacement of the site by scouring might have affected the lateral distribution of artifacts. Archeological evidence suggests that, despite those many disturbances, a substantial degree of horizontal integrity remained when artifacts were recovered in 2009. Study of the assemblage has demonstrated that the combination of natural and manmade processes has not completely disrupted the spatial relationship between artifacts on the seafloor.

ASSESSMENT OF NATIONAL REGISTER SIGNIFICANCE

In order to qualify for the National Register, a historic shipwreck site must have both significance and integrity. Historic significance depends upon *Westfield's* historic context, which must demonstrate the site's importance within the broad sweep of American history, architecture, archeology, or culture. Historic integrity refers to the site's ability to convey its significance. USS *Westfield* was determined eligible for the NRHP in 2007 based on significance criteria: A, B and D. Insights derived from subsequent artifact recovery and analyses support an argument for eligibility under Criterion C as well. As a U.S. Navy vessel during the Civil War, it was associated with events that made a significant contribution to the broad patterns of U.S. history (Criterion A), including pivotal Civil War battles at New Orleans and Vicksburg, the first Confederate surrender of Galveston, which was received by Commander Renshaw aboard *Westfield*, and the Union loss of Galveston, which arguably aided Texans in contributing to the Confederate War effort. Throughout its brief career, *Westfield* was associated with the lives of several persons significant in this nation's past (Criterion B), including Cornelius Vanderbilt who signed the bill of sale to the Navy (see Appendix A), Jeremiah Simonson, Charles Morgan, David Porter, and David Farragut. Artifacts associated with the steam engine and boilers have illuminated design details sufficient to allow substantial reconstruction of *Westfield's* propulsion system, contributing to an understanding of machinery used on Staten Island Ferries during the mid-19th century (Criterion C). As a rare surviving example of Staten Island ferryboats, *Westfield* has yielded significant information concerning the conversion of 19th-century ferryboats for naval service (Criterion D). Eligibility under Criterion D is further supported by artifact distributions, which have clarified historic accounts of *Westfield's* loss, an event that was arguably pivotal to the recapture of Galveston by Confederate forces, while also providing archeologists with information useful to understanding the preservation potential of heavily disturbed shipwrecks investigated in the future.

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CONCLUSIONS

This report represents the culmination of 14 years of marine archeological investigations associated with the TCCIP. Over that time span, Atkins's investigations of the site of USS *Westfield* (41GV151) have included numerous remote-sensing surveys using various combinations of marine magnetometer, side-scan sonar, sector-scan sonar, sub-bottom profiler, and ROV; three diving investigations totaling 64 dives by archeologists totaling over 72 hours of bottom time; and archeological salvage of *Westfield* resulting in the recovery of at least 8,380 artifacts. These efforts were undertaken in order to satisfy the responsibilities of the USACE under Section 106 of the National Historic Preservation Act (Public Law 89-665; 16 U.S.C. 470), which requires that Federal agencies take into account the effect that their funded or permitted projects have on historic resources, and the Antiquities Code of Texas (Texas Natural Resource Code, Title 9, Chapter 191) governing archeological discoveries on land owned by the State of Texas. These combined studies have produced a comprehensive archeological and historical analysis of a shipwreck that has immeasurable importance to the broader understanding of Civil War naval operations in Texas and along the U.S. Gulf Coast. The USACE determined that *Westfield* is eligible for the NRHP and requested concurrence of the Texas SHPO in 2006. Both the SHPO and NHHC concurred in 2007 that *Westfield* is eligible for the NRHP under criteria A, B and D

Westfield is far from being a complete vessel. Historic accounts of its explosion on New Year's Day 1863 state that the vessel forward of the smokestack was destroyed instantly down to the waterline. The explosion dispersed elements of the ship through the air over a radius of 400–500 ft. Portions of the ship that became airborne likely included the entire forward deck and hull (above the waterline) as well as most material below the forward deck. This event evoked dramatic descriptions from witnesses (Figure 305). Its force was characterized as being "so tremendous as to shake both the air and ocean like the upheaval of an earthquake. A volcanic fire ascended to the clouds in the form of an inverted cone, filled with shot and shell, and every conceivable form of fragments of wood and iron" (Abbott 1866:455). Within ten minutes of the magazine explosion the ship was ablaze and continued burning to the waterline. Over the next several months, Confederate salvers removed a large quantity of material from the wreck, including six of its seven cannon. Forty-three years later in 1906, the USACE used dynamite, divers, and a snag boat to clear additional material, from the site, believed to have included the steam engine and both boilers.

After 1906 the ship's remains were no longer a threat to navigation, so even though its location was charted on many 19-century maps, *Westfield* was largely forgotten over the next century. By the

FIGURE 305. DESTRUCTION OF USS *WESTFIELD* FROM FRANK LESLIE'S ILLUSTRATED NEWSPAPER.
COURTESY OF NEW YORK PUBLIC LIBRARY

time archeologists began earnestly trying to relocate the ship, its location and even its very survival were uncertain. *Westfield*'s magnetic anomaly was first charted by archeologists from EH&A (now Atkins) in 1991 (Hoyt 1992). Their survey was not specifically looking for *Westfield.* It included the entire HGNC. *Westfield's* anomaly seemed unremarkable at the time, being only one of 3,400 magnetic anomalies and 570 sonar targets charted by their survey, and was not recommended for further examination. In 1994 the USACE sponsored additional surveys to investigate specific areas of elevated historic potential in greater detail. One of the areas chosen was the vicinity of *Westfield*'s loss. A survey area of 29 acres, specifically designed to search for the ship, was chosen based on early attempts to geo-reference historic charts showing the wreck position (Hoyt et al. 1998:137). Three magnetic anomalies were charted by that survey, including one that years later proved to be associated with *Westfield.* Those archeologists did not realize at the time just how close they had been to discovery. Good justification existed at the time for not recommending the anomaly for additional investigations. The location was, after all, within the design prism of the Texas City Ship Channel. It seemed a reasonable presumption that, even if the anomaly was associated with *Westfield*, channel dredging long since would have impacted any potential for the site to yield significant information. That assumption remained intact until the site was actually confirmed by divers in 2005, and a new appreciation of the site's potential began to form. The USACE later determined from a search of its records in Galveston that the site had never been dredged, which went a long way toward explaining why so much material remained on the site.

ARCHEOLOGICAL RECOVERY

Archeological recovery of artifacts from *Westfield* took place in November 2009. The site is situated in the bottom of a federally-maintained navigation channel near one of the busiest shipping intersections in the world. High current velocities and low visibility conditions, in combination with heavy ship traffic, severely limited site accessibility. And the presence of unexploded ordnance posed a potential risk to divers and the surface crew. Concerns for safety of vessels, crew and divers led to a decision by the USACE and Atkins, in consultation with the NHHC and the THC, to adopt several nontraditional archeological excavation methods suited to the unique needs of the *Westfield* site. The most significant deviation from established archeological practice was the employment of a large electromagnet and an environmental clamshell dredge for the artifact recovery phase of investigations. These devices are not typically used within an archeological context; however, Atkins, USACE, Navy SUPSALV, and Donjon Marine worked diligently to adapt these tools for use on a historic site and were largely successful in recovering the artifact assemblage with minimal damage or loss of information. Being a predominantly disarticulated artifact debris field with no hull remaining, this wreck site was more amenable to the use of such devices than would be the case for a wreck with an extant hull.

The use of a clamshell at site 41GV151 was justifiable due to many site-specific factors including the lack of hull remains; deflation of the site to a thin layer of sediment overlying a sterile marine clay substrate; and the likelihood that spatial integrity of the site had been partially compromised by the magazine explosion, subsequent salvage, 1906 demolition, and erosion. The clamshell dredge recovered artifacts and their surrounding sediment matrix simultaneously, which allowed controlled archeological screening of the sediment (shell hash and silt). Screening of sediment using traditional archeological recovery methods, initially recommended, would have been limited to screening conducted by divers on the seafloor, because the water depth precluded lifting the sediment to the surface by suction means unless the material was passed through an impellor. Screening on the seafloor was never considered a viable option due to a number of factors including limited dive windows, low visibility, high currents outside of dive windows, and concerns for safety. The clamshell and electromagnet operations, supplemented by diving to lift individual larger artifacts, were ultimately successful in allowing archeologists to safely complete a systematic and controlled excavation of the *Westfield* site.

Use of the electromagnet resulted in raising 280, mostly large, iron artifacts in 43 lifts, averaging 9.7 minutes and 6.5 artifacts per lift cycle. This was a highly efficient process that greatly increased the productivity of operations, and allowed for the safe recovery of well-preserved iron artifacts too large to fit safely within the environmental clamshell. The magnet's effectiveness was further optimized by the fact that objects did not have to come into direct contact with the magnet surface in order to be raised. Any iron objects touching the magnet surface were themselves magnetized, effectively increasing the magnetic surface area and allowing adjacent objects to adhere to these magnetized artifacts. Furthermore, though the magnet did not clear every single iron artifact from the target areas, it was 100 percent successful in achieving its primary goal of clearing these areas of unexploded ordnance. Eight pieces of ordnance were recovered by the magnet, and none of the 10 pieces later recovered during clamshell operations came from an area that had been previously swept by the magnet.

The environmental clamshell successfully raised over 7,500 artifacts in 326 lifts, averaging approximately 7 minutes per lift cycle. The principal benefits of this method were clearly the speed and safety with which a large volume of artifacts were able to be recovered from a high-vessel-traffic area during a time-sensitive project. The clamshell operations cleared a 9,700-ft^2 area in 13 work days. The time needed to clear this same area using diver excavations and manual removal of artifacts is unknowable, but, based on the May 2009 field results, would have been on the order of 20 to 30 times longer in duration and a far riskier operation. Since clamshell operations were less dependent on varying weather conditions and currents than diving operations, the daily work windows were significantly extended, despite the fact that work was conducted in November. Also, clamshell operations rarely had to be suspended for passing ship traffic, which would not have been the case if divers were in the water.

The clamshell and electromagnet methods proved an imperfect solution to a complex problem; however, they are not recommended as substitutes for traditional archeological mapping and artifact recovery when those options are available and appropriate. Artifacts recovered *en masse* with a clamshell are unquestionably at greater risk to damage than those that are painstakingly and individually recovered by divers. Nevertheless, there was almost no evidence of damage to artifacts caused either by the clamshell or the magnet. Perhaps the fact that artifacts were lifted within a sediment matrix provided some protection. The most obvious damage to artifacts occurred to large, fragile pieces, such as the boiler flues and the firebox, that were lifted by the crane in diver-rigged slings. Such damage was unavoidable simply because the artifacts were already too severely deteriorated to support their own weight distributed over the relatively small lifting surface of the slings.

Two unavoidable downsides of using a clamshell were that a small fraction of artifacts were not recovered and that the accuracy of artifact provenience was limited by the clamshell's size. The potential loss of some archeological data, however, did not justify exposing divers and surface support crews to the considerable safety risks that would have been inherent in a full-scale manual excavation. In the end, the methods employed provided a successful resolution to the unique and numerous restrictions presented by this site.

ARTIFACT ANALYSIS

Despite all that has befallen *Westfield* since that fateful moment when Captain Renshaw lit his match, the site investigation has yielded information beyond anyone's initial expectations. The amount of fragile organic materials and small light-weight artifacts recovered from this high-current saltwater environment was an unexpected surprise, especially given that the site has migrated downward as much as 39 ft in the stern area. Obviously most of the sediment that originally underlay the site has long since washed away, yet many small artifacts remained behind. Even if the recovered artifacts represent a small sample of their original number, their preservation is nonetheless remarkable.

Iron and cupreous materials were preserved in far greater numbers than anything else. The largest portion of cupreous artifacts was fasteners; however, many unique objects were discovered that shed interesting light on various aspects of shipboard life. Most of the iron artifacts were encased within concretions, necessitating 2,093 x-ray images to determine the nature of artifacts contained within. The form and function of concreted iron artifacts often was completely unrecognizable when first pulled from the water. Yet once the concretion was removed, the diversity of objects represented and the amount that could be learned from the assemblage of iron artifacts was exciting.

Analysis of the artifact assemblage, viewed in the context of archival and published historical materials, has greatly contributed to our understanding of USS *Westfield.* Conclusions pertaining to each of the research topics identified in Chapter 5 are summarized below. Those topics include: (1) Ship construction, conversion and outfitting of the ship for military use; (2) Corroboration of historical accounts; (3) Effects of destruction, salvage, demolition and erosion; (4) Insights into shipboard life; and (5) Evidence of horizontal integrity.

SHIP CONSTRUCTION, CONVERSION AND OUTFITTING

Construction Details

Westfield lacks extant hull features. Nevertheless, the authors have a good general understanding of how Vanderbilt ferries were designed and built based on evidence from archival sources and from archeological examples of similar boats. Simonson Shipyards was used primarily for construction. The same basic hull plan was used over a long period of time in order to make each ferry consistent with the design of ferry terminals at Whitehall and Staten Island. The shapes of the bow and stern were identical. This allowed all the ferryboats to dock within terminals matching their hull shapes on both sides of the harbor. Even when using an outside construction company such as John Englis or Lawler Marine, builders of *Southfield* and *Southfield II* respectively, the same general shape was used in order to permit ferries to successfully dock. The construction of machinery also followed the same general designs from one ferryboat to the next, even when constructed by different ironworks.

When excavations first recovered *Westfield*'s artifacts, the assemblage resembled a collection of concreted scrap iron. Yet after conservation efforts removed the marine concretion, the features of numerous machined and complex cast iron components became visible. Careful observation and study determined that many of the artifacts originated from *Westfield*'s walking beam engine and boilers. Those fragments provided considerable information regarding the design and dimensions of *Westfield*'s machinery allowing detailed digital reconstruction of many components (Figure 92). To be sure, the engine and boiler reconstructions relied on historic drawings as a starting point; however, insertion of actual artifact details into those drawings has conveyed a level of confidence in reconstructions that would otherwise be impossible.

A digital reconstruction of the hull lines (Figure 306) was achieved in a similar manner as for the engine and boilers, although fewer artifacts associated with the hull were available to assist with the process. Only very small fragments of wood remain that in a few cases might have been part of the hull. The most common indirect evidence of the hull exists in the collection of over 1,800 tacks, nails, spikes, bolts and screws recovered from the site. Lengths of various fasteners can shed light on the timber dimensions used in construction, providing confirmation of construction details surmised from historical sources and archeological sites of similar ferries. A theoretical hull plan for *Westfield* as a ferryboat was largely based on drawings of *Southfield II* by William Cowles (1886). As with the engine and boiler reconstructions, details from artifacts have been incorporated wherever possible. The resulting hull plan also was used by archeologists as the basis for interpreting the distribution of artifacts.

The process leading to this reconstruction proves that even the most scant archeological resources can be an asset if properly utilized. *Westfield*'s artifact assemblage presented a unique opportunity to examine an early American steam engine and to answer questions about how the individual components operated together. While *Westfield*'s machinery is only 150 years old, the design is now largely forgotten or misunderstood. A large portion of the conserved artifact assemblage and a large mural of the ship reconstruction are planned for permanent display at the Texas City Museum.

Military Conversion and Outfitting

Changes to the hull made during gunboat conversion were deduced mainly from the Memphis Drawing (Figure 3) and from proposals by Copeland and Howe (1861a, 1861b and 1861c) to outfit *Westfield* as a gunboat. *Westfield*'s artifact assemblage has supplemented the historic record with interesting details concerning the ship's conversion and outfitting as a military vessel. The contrast between *Westfield's* military and civilian appearance was significant (compare figures 2 and 3). The saloon deck was removed, and the main cabin was lowered by 2 ft. Most of the Victorian era decorative features likely were removed, although a few examples of ornate brass work were recovered from the site. The wheel houses were rebuilt. The A-frame was more exposed. The smoke stack was shortened. Large cabin windows were replaced with portholes. The sides of the ship were

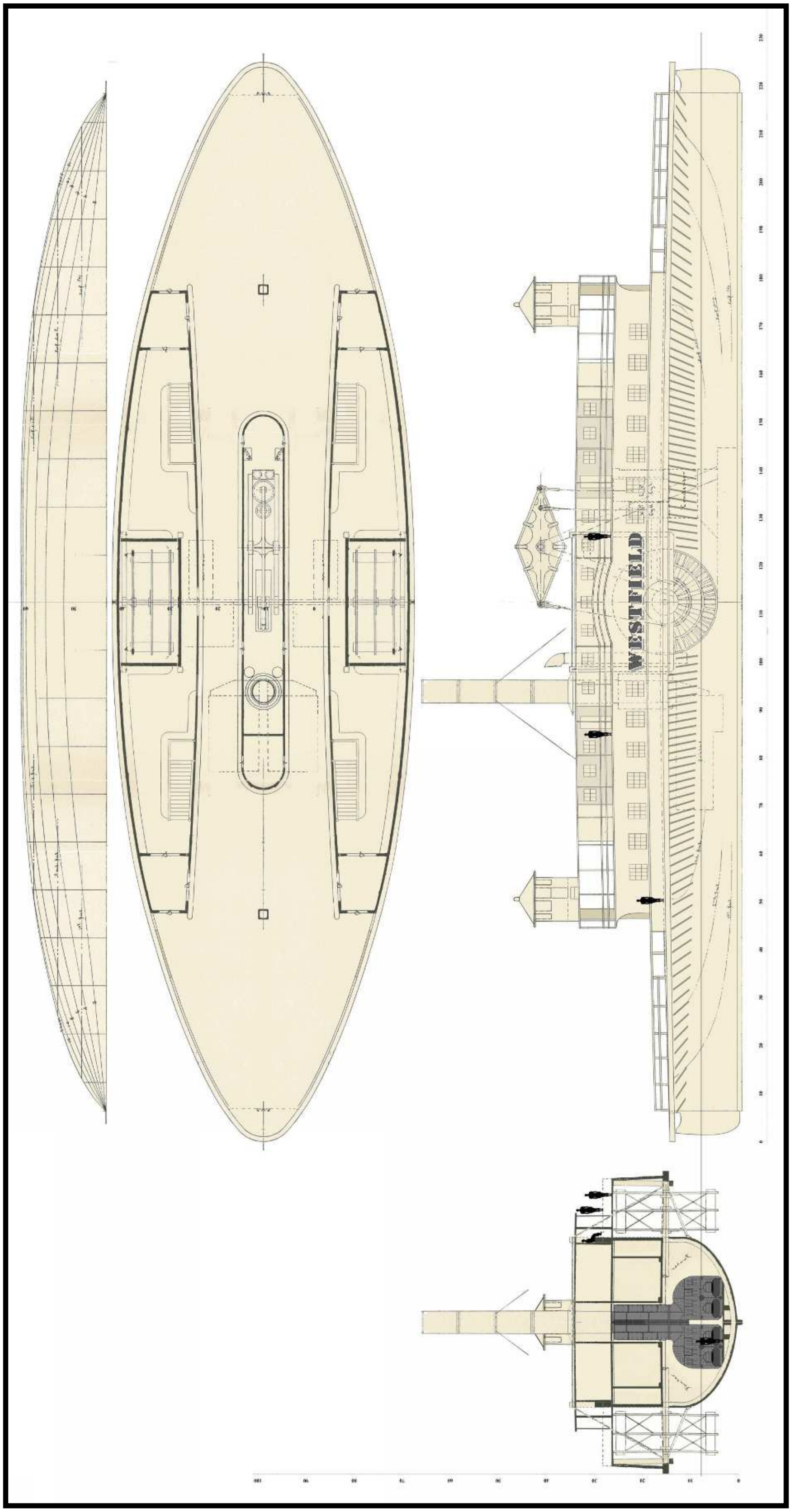

FIGURE 306. DIGITAL RECONSTRUCTION OF *WESTFIELD* HULL PLAN (BY JUSTIN PARKOFF)

armored with sheets of iron boiler plate, which were hinged for raising and lowering in areas where gun ports were required. Powder magazines and shell lockers were constructed below both bow and stern decks.

Among the most prominent artifacts indicative of its military career is the 9-inch Dahlgren cannon and assorted munitions recovered from the site. The remaining 9-inch Dahlgren was discovered in 2005 and was found to be overturned, similar to one of the guns salvaged in 1863 (*Houston Tri-Weekly Telegraph* 1863a). It was situated in the northwestern portion of the wreck site and, based upon its orientation to the firebox, would have been originally positioned on the stern deck at the starboard side of the vessel. Assorted tackle from at least one gun carriage also was recovered.

The most abundant remnants of military conversion recovered from the site are fragments of iron plating used for armor, as depicted in an eyewitness scale drawing of *Westfield* (see Figure 3) and on numerous historic photographs of converted ferries (figures 4-6, for example). The gun deck had hinged metal plates that could be raised or lowered to facilitate use of the cannon. Over 590 iron plate fragments were recovered. Most of these are fragments from the boilers, although larger examples of flat iron plate, distinguishable by their fastener pattern, served as armor protecting the cabin, the decks, and the hull above the waterline.

Originally the ship would have had large rectangular windows along the sides of the cabin. Window sash weights from the original windows apparently were left in the cabin walls during conversion, as several were recovered from the site. The cabin windows were removed and boarded over prior to adding armor plates. A row of portholes was added above the armor plates to let light into the officer cabins. The contemporary sketch of *Westfield* (Figure 3) is the only historic source suggesting that portholes were installed as part of the conversion to military service. Fragments of two portholes were recovered, one from the cabin and the other believed to have been a lower hull porthole from below the guards, letting light into the engine room during the ship's ferryboat days. It seems that the engine room portholes were left in place when the sponsons were enclosed during gunboat conversion.

CORROBORATION OF HISTORICAL ACCOUNTS

Historical accounts of *Westfield's* destruction (summarized in Table 4) are highly contradictory. There is little agreement regarding Captain Renshaw's final actions, although there seems to have been nearly universal derision by his fellow officers of his decision to destroy the ship. Whether deserving or not, Renshaw was made a scape goat. He was discredited by his contemporary officers with making many poor decisions leading to the loss of Galveston including: landing the 42nd Regiment on the wharf instead of at Pelican Spit; assigning the difficult-to-maneuver *Harriet Lane* to Kuhn's Wharf instead of a double-ended ferry; hailing *Clifton* to *Westfield*'s aid after Confederate troops were observed advancing on the wharf; and destroying *Westfield*.

Given that *Westfield* has been rediscovered and in a way resurrected, this author felt it appropriate to objectively reassess Commodore Renshaw's decision to destroy his flagship, separated from the emotion of the moment by 152 years. Renshaw's actions have been much maligned by his contemporaries; however, based on the circumstances, it would seem his decisions were justifiable. Whether another officer would have made the same decisions can never be known.

After careful review of eyewitness reports (Table 4), the most reliable interpretations of *Westfield*'s final actions agree the gunboat was heading stern-first (based on gun placements) toward the west-northwest in pursuit of Confederate gunboats when it grounded. Navigating under such conditions in the vicinity of shoals, at night, without a pilot on board, and without aid of the Bolivar Lighthouse, burned by Confederates 2 days earlier, would have been fraught with risk. As a result, the ship ran hard aground on a sandbar at around 2 A.M. on a night when the tide would continue falling to one of its lowest levels of the year. The stern of *Westfield* was firmly stuck and could not be freed.

Renshaw presumably was familiar with Galveston tides after a stay of two and a half months. He certainly would have been aware, based on the tidal pattern over the prior few days and on the phase of the moon, that he could expect very low tides of long duration between extremes. He may have known when *Westfield* ran aground on a falling tide at 2 A.M. that the tide would not slack until after 10 A.M. and that the next high tide would not occur until about 4 P.M.

Renshaw's decision to request *Clifton's* assistance in the early morning hours made sense. The tide had continued to fall since *Westfield* grounded and would not rise sufficiently to perhaps float the ship, or at least facilitate pulling her free, until late afternoon. If *Clifton* was successful in pulling *Westfield* free, he would have two able gun ships with which to attack. If he didn't try to pull *Westfield* free, he was guaranteed to have only *Clifton* for that purpose. If he waited, the falling tide would only worsen the ship's predicament. By the time he realized *Clifton* was not up to the task of freeing *Westfield* from the sandbar, it was too late to save *Harriet Lane* or the Union troops at Galveston. The sun rose on January 1, 1863 with Galveston firmly in Confederate hands and *Harriet Lane* captured.

By 8 a.m. Confederate terms for his surrender were being delivered to Renshaw by Captain Law aboard *Clifton*. At that point, he had three choices: 1) surrender and lose every ship with all of his forces taken prisoner; 2) attempt to retake Galveston with a diminished force, with no element of surprise, and with no intelligence regarding the strength of Confederate guns delivered during the previous night; or 3) retreat and cut the Union losses. Renshaw probably made his decision known to the other officers shortly after 8 A.M. when he was visited by Captain Law from *Clifton,* ostensibly to discuss the terms of the Union surrender, while under the Confederate's flag of truce.

Renshaw's decision to retreat seems reasonable under the circumstances and would have required him to destroy *Westfield* to prevent its capture. Had the Confederates taken the ship, it most certainly would have been refloated in perfect condition on the next high tide. The ship was armed with 7 heavy guns, was fast, maneuverable, and had a shallow draft suitable to Texas inlets. *Westfield* also was reported to have carried ammunition stores for the West Gulf Blockading Squadron (Edward Cotham, electronic communication 2009). In fact, *Westfield* took on new ammunition stores on December 28, just days before the battle (Cotham 2006:127). Renshaw clearly did not want the ship falling into enemy hands.

The next morning Captain Renshaw destroyed his ship in an ill-timed explosion that took his life and those of several officers and crew. Historic accounts of the explosion, summarized in Table 4, contain several conflicting versions casting doubt as to which end of the ship exploded. The position of the Dahlgren cannon northwest of the firebox, combined with the low density of artifacts, especially fasteners, southeast of the firebox, fully supports the accounts by the nearest eyewitnesses that Renshaw detonated the forward magazine.

Several boiler artifacts show indications of an explosion originating from inside the boiler. Jagged metal was pushed from inside toward the boiler exterior, suggesting that an explosion occurred, yet no historic accounts specifically mention a second explosion. Only Scharf's (1886: 507-508) account of "another flash" could remotely be interpreted as a referring to a second explosion. Several accounts agree that the boilers' safety valves were chained down, so it seems clear that Renshaw intended for the boilers to blow. Whether an imminent boiler explosion was immediately precipitated by the magazine explosion or occurred about 10 minutes later is uncertain. In either event, the authors believe that one or both of the two boilers exploded. Given the weak historic case for a second explosion, the most likely scenario seems to be that one or both boilers exploded simultaneously with the magazine.

Major Burt (1863), an eyewitness to *Westfield's* destruction from the vantage point of *Mary Boardman*, reported that "…her guns aft, which were double-shotted and run out, as the flames should reach them, threatened us, at the short distance we were from her, with destruction, which might have been foreseen when she was fired." He must have referred to the two Dahlgrens, since the four Columbiads and the 32-Pounder on the bow likely tumbled into the water when the magazine exploded. As we now know, the Dahlgren recovered by archeologists was loaded but was not double shotted. Burt's statement that the stern guns threatened them with destruction might have been intended more for dramatic effect in making his case for the ineptitude of Commodore Renshaw. It seems unlikely that either Dahlgren was directed toward *Mary Boardman*. The pivot-mounted Dahlgren presumably was pointed astern (more or less northwestward) and the Marsilly-mounted Dahlgren roughly southwestward. Both guns were probably pointed over water too shallow (see figures 18 and 19) for *Mary Boardman* to safely navigate. Incidently, the Marsilly-mounted Dahlgren, almost surely the one that was recovered, is believed to have been originally on USS *Clifton*. Eventually this might be proven through research of the gun's serial number. Unfortunately that question was not settled by the time of this writing.

Witnesses describe the magazine explosion as immense. The magazine would have been located near the bottom of the hull, directly above the keel. The keel is believed to have blown apart beneath the magazine, as Andrew Thompson, one of the Confederate salvers, reported, "I found the wreck to consist of about one half of the hull of the vessel embedded in the sand and in about six feet of water – The decks were burned off of her forward [*sic* aft] and the stern [*sic* bow] part blown off about sixty yards (the main part of the stern [*sic* bow])" (Appendix A-2, Letter 7). Thompson confused the two ends of the ship; an easy mistake considering it was double-ended with two rudders and was missing above the waterline when he dived on it.

From Thompson's statement and knowing that Westfield was steaming on a northwesterly heading when it struck the sand bar, one can surmise that the east end of the ship is the one that exploded and separated from the rest of the boat. The relative positions of large artifacts (including the Dahlgren) indicate that *Westfield* was passing through Bolivar Channel stern-first. No accounts specify this detail; they only indicate *Westfield* was traveling up the channel when it ran aground and that both Dahlgren cannon were aft of the wheelhouse (Appendix A-2, Letter 8). Thus, the end Thompson found with the decks burned off, embedded in sand in 6 ft of water, had to be the western end and the stern, while the bow must be the end that separated from the rest of the ship. Thompson did not state in which direction the bow was displaced, but two clues suggest it must have moved toward the east. First of all, the bow would have been floating in deep water on the east side of the explosion, thus the force of the blast might have provided momentum in that direction. Second, Major Burt reported, and NOAA predictions corroborate, that the tide was ebbing when Captain Renshaw made the decision to destroy the ship. An ebbing current would have transported the bow eastward, along with any other buoyant wreckage, carrying with them fittings and fasteners of all sizes. By 10 A.M., the time of the explosion, the tide might still have been ebbing or nearly slack. In either event, the momentum from the blast alone might have been sufficient to transport the bow 60 yards through the water column before it settled to the seafloor. The final location of the bow has never been archeologically confirmed.

The small amount of ordnance recovered by archeologists (25 versus at least 200 by salvers in 1863) attests to the thoroughness of the original salvage efforts at retrieving munitions. At least 12 of the 25 recovered shells were fused, meaning that they were charged with powder and would have been stacked on deck, ready for use, rather than stored below deck. It is interesting that 9 of 12 fused shells (not counting the one in the Dahlgren) were 9-inch rounds from the aft deck, and 17 of 25 shells recovered were 9-inch, again presumably from the aft part of the ship. Both observations are consistent with the destruction of the forward deck by the magazine explosion.

EFFECTS OF DESTRUCTION, SALVAGE, DEMOLITION AND EROSION

The distribution of artifacts, and in particular fasteners, from the site supports the historic account by Confederate salvers that *Westfield*'s bow separated from the rest of the ship and drifted away due to explosion of the forward magazine. The explosion instantly dispersed elements of the ship from the bow to the smokestack through the air over a radius of 400–500 ft. Evidence of an explosion observed on some boiler fragments suggests that one or both boilers also exploded, probably when the magazine blew up. At least two cannon were moved 30 ft from the main body of the wreckage. The wooden superstructure burned to the waterline, so anything remaining on the aft deck following the explosion ended up in the water. If the recovered Dahlgren was run out onto the ship's guards, it likely tumbled into the water outside of the hull where it became buried, thus helping explain why it was missed by salvers.

What is immediately apparent upon even a cursory review of the artifact assemblage is the extensive amount of material that was removed from the site, both by Confederate salvers and by demolition in 1906. This is apparent not only from the Prize Commission Records but also from the types of materials that remained at the site. Confederates recovered 9,718 pounds of iron, 3,300 pounds of boiler iron, and 424 pounds of brass, in addition to a varied collection of objects including armament and machinery (Appendix A-2, Letter 17). Much of the artifact assemblage is unidentifiable or in fragments, and what is conspicuously absent from the site are almost all large pieces of machinery, valves, and pipes. The most extensive salvage in 1863 presumably occurred on the aft half of the ship where undamaged materials were removed from the hold by divers. The quantity of intact materials salvaged from the hold, including five barrels of meat, a barrel of beans, and six coils of rope, negates the possibility that both magazines exploded and corroborates a report by Abbott (1866:456) specifically stating that the aft magazine did not detonate. If the aft magazine had also exploded, salvage would have been limited mainly to durable items, such as cannon and machinery.

By 1906, when the snagboat *General S.M. Mansfield* dynamited and removed portions of the wreck, most of the exposed wood had eroded away above the sediment (*Galveston Daily News* 1906). Water depth at the site was charted as 30 ft at the time, and what is believed to have been the top of the engine cylinder was reportedly 4 ft beneath the surface. The reconstructed height of engine and boilers indicates that the boilers would have been completely exposed above the seafloor in 1906. Any wooden hull remaining at that time would have been limited to a vertical thickness of at most 3 or 4 ft and extending not more than 20 ft wide. In other words, the vast majority of hull had long since deteriorated by 1906. The fact that some hull was still buried at that time indicates that at least some fasteners were in their original positions before demolition began. No detailed records of the 1906 demolition have been found, so there is no way to know whether the site below the sediment was substantially disturbed. It is presumed that most of the demolition focused on exposed materials that posed an immediate hazard to navigation. The boilers and engine cylinder are believed to have been the only relatively intact pieces of machinery remaining on the site at the time.

Only two small pieces of copper sheathing were recovered in 2009, despite the hull having been coppered with at least 3,400 ft^2 of sheathing, up to her 8-ft draft mark. At least a third of this sheathing likely was immediately displaced from the site by explosion of the forward magazine.

Since most of the remaining wood hull had eroded above the mudline by 1906, the absence of sheathing in 2009 indicates either that currents washed away the remaining sheathing after the wood hull deteriorated or that sheathing was salvaged during the 1906 site demolition. When *Westfield* was salvaged in 1863, exposed sheathing likely was recovered; however, sheathing embedded in sediment beneath the hull, would have been inaccessible at that time. Subsequent deterioration of the hull over the 43-year period leading up to 1906 would have made the underlying copper sheathing more accessible than it was in 1863.

Since few details of the 1906 demolition are known, the final disposition of sheathing will remain unresolved. Large quantities of copper and brass were reportedly recovered in 1906, but whether some of that copper was sheathing is unknown. Considering that dynamite was used to break up the wreck, it is possible that buried portions of the hull were pulled up in pieces along with sheathing and fasteners. The possible removal of selective portions of the lower hull in 1906 might explain the uneven distribution of fasteners recovered aft of the bow area in 2009. In particular, relatively few fasteners were recovered from the starboard midship area south of the engine room (see Figure 298). The overall abundance of sheathing tacks recovered from the aft part of the site, however, points to a predominantly natural loss of the sheathing there rather than from salvage.

A substantial amount of the larger artifacts recovered from the site are from the boilers and engine. *Westfield* is believed to have been equipped with two tubular return flue boilers. Several components of the boilers have been identified including portions of two boiler flues, boiler mounts, and the base of one firebox with most of the fire grates in place. Other components recovered from the boilers include internal staybolts, firebox hatches, metal plates and internal stress supports. None of these objects would have been left on the seafloor if the boilers had been removed completely intact.

The distribution of artifacts suggests that demolition in 1906 substantially dispersed many internal elements of the boilers. For example, the boiler flues were located 60 ft northwest of the firebox. The firebox is believed to lie close to its original position, since the majority of the fire grates, held in place only by gravity, were properly articulated within the box. Substantial movement of the box likely would have disturbed the pattern of grates. Other boiler parts were dispersed across the intervening area between the flues and the firebox. The authors theorize that the snag boat *General S.M. Mansfield* attempted to lift the boilers intact but that at least one of the boilers broke apart during the process, dropping a trail of parts as it was dragged across the seafloor toward the snag boat.

Reconstruction of *Westfield's* machinery plan, when compared with water depths reported in 1906, demonstrated the likely condition of the site prior to demolition. The engine cylinder was reportedly only 4 ft beneath the waterline in 1900, so based on engine and boiler dimensions from a reconstruction of *Westfield's* machinery (Chapter 7), the base of the fireboxes (the lowest point on the boilers) would have been about 27 ft below the surface. Water depth near *Westfield* was charted at 30 ft deep in 1904 (USACE 1905), so clearly the demolition divers had full access to both the engine and the boilers when conducting their work.

The snag boat *General S.M. Mansfield* (Figure 15) was equipped with a large A-frame crane on its bow. The wreck was cleared by a combination of dynamiting and lifting. Presumably dynamiting would have been employed on objects too heavy to remove in one piece, but lifting of intact structures would have been used as a first option whenever feasible. Limitations imposed by tidal currents over the site would have required the snag boat to anchor up current from where it was working. Unless the crane was positioned directly over the boilers, a position not likely when dynamiting was required, lifting them would have involved some degree of dragging up current before they left the seafloor. Dragging the boilers up current during an ebb tide would have distributed any falling parts in the general direction of where the flues were recovered.

The bottoms of the boiler barrels rested on mounts above the base elevation of their respective fireboxes, which should have provided demolition divers with access beneath the barrels to wrap straps or cables for lifting. The drums would have been located southeast of the fireboxes, so dragging from an up current position, northwest of the boilers, could have accounted for rotation of the firebox discovered on the site and for spilling of about one fourth of its fire grates when the drum finally broke free. This scenario is consistent with the tight grouping of six boiler mounts discovered clustered in an 11-ft-diameter area approximately 10 ft north of the firebox (Figure 36). The original positions of those mounts should have been southeast of the fireboxes. Two other boiler mounts were discovered 30 ft northwest of the boiler flues, nearly 100 ft from their original position. These might have been concreted to one of the boiler drums, eventually dropping to the seafloor before the boiler was completely removed from the site.

Fragments of the steam engine are made of heavier metal than the boiler pieces. These fragments were not created through natural corrosion processes. The engine was clearly dynamited to break it up. Interestingly though, all of the engine fragments, for which position on the engine can be determined, are from low elevations near the base of the piston/condenser and the air pump/hot well cylinder assemblies. Rather than breaking the engine into many parts, the demolition crew might have focused on dynamiting the base of the engine to break it free, so the upper sections could be lifted intact. This could explain why no parts from higher up on the cylinder assemblies have been identified.

The distribution of small artifacts, discounting boiler parts which we now believe were widely dispersed in 1906, suggests that erosion of the site has not radically altered the positions of remaining artifacts. Despite the fact that the hull has long-since deteriorated, for example, many fasteners from the hull seem to have remained in place during the process of erosion. Of course, we will never be able to say how many artifacts washed away from the site over the decades. Their numbers are probably quite high. Nevertheless, it is amazing, given the degree of severe disturbances to the site both cultural and natural, that so much material seems to have moved very little, in the horizontal dimension at least, from its original position.

SHIPBOARD LIFE

Relatively few personal items were recovered from *Westfield*. Preservation of organic and/or fragile materials was somewhat better than expected; however, given the nature of the site and environmental conditions, those expecations were low to begin with. Many artifacts reflective of sailor's personal lives likely were taken by their owners when the ship was evacuated. Most such items tend to be small and if left behind would have been susceptible to washing away. The types of artifacts most likely to have remained would be items that belonged to the ship, including durable hardware components of tools, cooking utensils and surplus equipment used by individual sailors and marines.

A small variety of fragile, organic artifacts was recovered, despite the relatively poor preservation of such materials at the site. A larger number of light-weight, durable artifacts were recovered. A few items related to personal clothing and gear survived, including part of a key, strap hooks, brass buttons, the leather heel of a boot, clasps, locks, latches, assorted pieces of hardware, tools, ceramics, glass, and various small cupreous objects. Some of the small clasps and hinges might have been parts of seamen's storage chests, foot lockers, or other types of storage boxes. Military issued personal articles recovered include: Union "US" belt buckles and cartridge box plates, a clasp and hook from a backpack, the cap from an oil bottle issued to marines for maintenance of their Enfield rifles, part of a cleaning rod from an Enfield rifle, and a hook from an Enfield shoulder strap.

A handful of artifacts have been identified that might have been used by the ship's officers. Examples include: part of a small brass oil lamp; what appears to be part of a navigational sextant; part of a beam compass, perhaps used for plotting courses on navigational charts; the silver-plated cap to a condiment dispenser from a decorative tableware set; fragments of bottle glass likely used for wine and other spirits; fragments of stoneware, porcelain, whiteware and ironstone, some of which might have been used in the officer's mess; and a badly-burned fragment of a book, possibly a ledger of some sort, with a brass spine.

Each unique reminder of shipboard life recovered from *Westfield* was celebrated largely because there were so few. For example, two tourniquet buckles are the only evidence recovered of what would have been a much more extensive medical capability on board. A small number of hand tools were recovered including several files of different types, the head of a hammer, a possible hole punch, and a weight from a balance scale. The number and variety of tools issued to *Westfield* was much more extensive than what was represented in the artifact assemblage. A cast iron stove cover and a few cattle bones with butcher marks are practically all the evidence remaining of the ship's galley, which daily fed 130 men. The scarcity of such materials was a reminder of how many similar artifacts were not recovered.

There is no doubt that many more artifacts of a personal nature, including ship-owned items assigned to or associated with individuals, washed away over the years or were too fragile to survive. The relatively small collection of such materials recovered from the site merely provides a glimpse into the daily lives of *Westfield*'s officers and crew. The discovery of personal artifacts and items used by individual crewmembers to perform specific shipboard functions provide human connections to *Westfield* and to the historical events with which the ship is associated. Such personal connections help bring the ship's history to life in a way that armament and architecture alone cannot. While items representative of shipboard life are a relatively small part of *Westfield*'s artifact assemblage, they provide an important tool for engaging the public in the story of this ship and its role in the larger events of its day.

EVIDENCE FOR HORIZONTAL INTEGRITY

Today the site is only a shadow of what *Westfield* once was. It was determined early in these investigations that the site was a disarticulated artifact debris field, limited to a thin layer of weakly consolidated sediment, overlying a sterile marine clay deposit, and without evidence of hull remains. It was clear that the site could not retain meaningful vertical stratigraphy. Most of the sediment that originally underlaid the site had long since washed away, yet many small artifacts remained behind. In the stern area as much as 39 ft of sediment had washed away between 1863 and 2009.

The distribution of artifacts has shed considerable light on the extent of damage caused by explosion of the forward magazine. The visible debris field appears to represent only *Westfield*'s stern and midships aft of the bow deck. The general area of the forward magazine lacked visible sonar targets and was characterized by lower magnetic anomaly amplitude than aft of the firebox. The most abundant artifacts in the forward section were relatively light-weight coal and brick fragments that could be easily transported by current. The density of artifacts forward of the firebox was very low by comparison with the remainder of the site. Very few fasteners were recovered forward (southeast) of the firebox in the vicinity of where the forward magazine exploded. Such distribution cannot be explained by post-deposition environmental factors, as both ends of the site have been subjected to the same conditions. The best explanation for the uneven artifact distribution appears to be the dispersal of fasteners and other artifacts during and immediately following explosion of the forward magazine, consistent with one historic account of the bow having moved 60 yards away from the remaining hull as a result of the magazine explosion.

Boiler components, with the exception of the mostly intact firebox, seem to have dispersed more broadly than other metallic artifacts. This is consistent with what can be surmised about the 1906 demolition activities, which seem to have targeted the boilers and engine. The boilers were constructed of much lighter material than the engine, and are believed to have violently ruptured during the magazine explosion. The distribution of boiler fragments across a large area of the site suggests that one or both boilers, probably already badly damaged, partially disintegrated during efforts by the snag boat to remove them in 1906.

Several artifact groups, including fasteners, engine room artifacts, and munitions, have generally retained horizontal integrity. The most telling of these distributions is that of fasteners. Over 1,800 fasteners have been documented including 1,565 nails, 143 spikes, 94 bolts, and 18 screws. Small cupreous tacks were used for attaching copper sheathing to the hull. Cupreous spikes were used to nail hull planks to the frames and deck planks to the deck beams. Long cupreous bolts were used along the keel and sister keelsons. It is apparent that a large number of fasteners fell out of the wooden hull as it decayed and, as a group, did not move substantially since then. While certain artifact groups moved more than others, particularly boiler artifacts affected by 1906 demolition operations and munitions likely to have been on deck when the ship exploded, the smallest and most abundant artifacts, hull fasteners, were held in place as the hull deteriorated. Even after the hull rotted away, a substantial number of fasteners of many types resisted movement by strong daily tidal flows and by the severe currents associated with hurricanes. Despite vertical erosion of up to 39 ft of sediment from beneath *Westfield*, all indications suggest that the horizontal distribution of fasteners in 2009 reflected the position of the ship's hull in 1863.

POSTSCRIPT

The history of our Nation is preserved mainly in books and museums. An archeological find such as *Westfield* animates that history for posterity. We are reminded that real people lived and died on this ship in the midst of our Nation's greatest civil conflict. Only months before its demise, New Yorkers were commuting to work on her decks, perhaps reading news accounts of the growing war, unaware that soon the humble ferryboat on which they rode would be sold into that very conflict. Once entered into naval service, *Westfield* played a small but vital part in battles for control of the Mississippi River before coming to Galveston. Even there the ship played a pivotal role. Its loss on a sandbar might have meant the difference between victory and defeat for General Magruder's Confederate forces in the Battle of Galveston. Following its destruction, *Westfield* quickly passed from being a newsworthy maker of history to being mined for its resources of guns and metal. Over time the steamer became merely a curious navigational hazard until even its location was forgotten. Rediscovery of *Westfield* has breathed life into events touched by its past. Once again the gunboat is both newsworthy and a valuable resource, this time though to be mined not for guns but for history.

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